

September 2010



Bibliometric Analysis of INMHA-related Research, 1997-2008

Vincent LARIVIÈRE, Benoit Macaluso,
Jean-Pierre ROBITAILLE, Pascal Lemelin
and Philippe MIRABEL
Observatoire des sciences et des technologies (OST)

Eric MARCOTTE
CIHR Regenerative Medicine and Nanomedicine Initiative (RMNI)

Nathalie GENDRON
CIHR Institute of Neurosciences, Mental Health and Addiction (INMHA)

Prepared for
INMHA-CIHR

TABLE OF CONTENTS

FIGURES	II
TABLES	III
INTRODUCTION	1
1 METHODS	3
1.1 DATABASE	3
1.2 RETRIEVAL OF PAPERS IN EACH OF THE DOMAINS	3
1.3 INDICATORS	5
2 GLOBAL TRENDS.....	7
2.1 NUMBER OF PUBLICATIONS	7
2.2 SPECIALIZATION	10
2.3 COLLABORATION.....	11
3 NEUROSCIENCE	14
3.1 NEUROIMAGING.....	17
3.2 NEURAL STEM CELLS	20
4 MENTAL HEALTH	23
5 ADDICTION.....	26
6 SENSES AND COMMUNICATION DISORDERS	29
6.1 PAIN	32
7 CROSS-CIHR STRATEGIC INITIATIVES.....	35
7.1 REGENERATIVE MEDICINE	35
7.2 NANOMEDICINE	38
7.3 EPIGENETICS.....	41
CONCLUSION	44
ENDNOTES.....	46
APPENDIX 1. MESH TERMS, BY DOMAIN.....	47
APPENDIX 2. JOURNALS INCLUDED, BY DOMAIN	49

FIGURES

Figure 1	Number of canadian papers, by domain, 1997-2008 _____	7
Figure 2	Canadian papers' percentage of world papers, by domain, 1997-2002 and 2003-2008 _____	9
Figure 3	Canada's specialization index, by domain, 1997-2002 and 2003-2008 _____	11
Figure 4	International collaboration rate of Canadian papers, by domain, 1997-2002 and 2003-2008 _____	12
Figure 5	Inter-institutional collaboration rate of Canadian papers, by domain, 1997-2002 and 2003-2008 _____	13
Figure 6	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neuroscience, 1997-2002 and 2003-2008 _____	15
Figure 7	Network of collaboration of Canadian institutions in the domain of Neuroscience, 1997-2008 (50 joint publications or more) _____	16
Figure 8	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neuroimaging, 1997-2002 and 2003-2008 _____	18
Figure 9	Network of collaboration of Canadian institutions in the domain of Neuroimaging, 1997-2008 (10 joint publications or more) _____	19
Figure 10	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neural Stem Cells, 1997-2002 and 2003-2008 _____	21
Figure 11	Network of collaboration of Canadian institutions in the domain of Neural Stem Cells, 1997-2008 (3 joint publications or more) _____	22
Figure 12	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Mental Health, 1997-2002 and 2003-2008 _____	24
Figure 13	Network of collaboration of Canadian institutions in the domain of Mental Health, 1997-2008 (15 joint publications or more) _____	25
Figure 14	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Addiction, 1997-2002 and 2003-2008 _____	27

Figure 15	Network of collaboration of Canadian institutions in the domain of Addiction, 1997-2008 (5 joint publications or more) _____	28
Figure 16	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Senses and Communication Disorders, 1997-2002 and 2003-2008 _____	30
Figure 17	Network of collaboration of Canadian institutions in the domain of the Senses and Communication Disorders, 1997-2008 (8 joint publications or more) _____	31
Figure 18	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Pain, 1997-2002 and 2003-2008 ____	33
Figure 19	Network of collaboration of Canadian institutions in the domain of Pain, 1997-2008 (5 joint publications or more) _____	34
Figure 20	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Regenerative Medicine, 1997-2002 and 2003-2008 _____	36
Figure 21	Network of collaboration of Canadian institutions in the domain of Regenerative Medicine 1997-2008 (5 joint publications or more) _____	37
Figure 22	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Nanomedicine, 1997-2002 and 2003-2008 _____	39
Figure 23	Network of collaboration of Canadian institutions in the domain of Nanomedicine, 1997-2008 (3 joint publications or more) _____	40
Figure 24	Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Epigenetics, 1997-2002 and 2003-2008 _____	42
Figure 25	Network of collaboration of Canadian institutions in the domain of Epigenetics, 1997-2008 (4 joint publications or more) _____	43

TABLES

Table 1	Number of papers retrieved from PubMed and number and percentage of these papers recalled in the Web of Science _____	4
Table 2	Overlap between the each of the domains _____	5
Table 3	Canada's world rank in terms of number of papers, by domain, 1997-2002 and 2003-2008 _____	10

Table 4	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neuroscience, 1997-2002 and 2003-2008 _____	14
Table 5	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neuroimaging, 1997-2002 and 2003-2008 _____	17
Table 6	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neural Stem Cells, 1997-2002 and 2003-2008 _____	20
Table 7	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Mental Health, 1997-2002 and 2003-2008 _____	23
Table 8	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Addiction, 1997-2002 and 2003-2008 _____	26
Table 9	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of the Senses and Communication Disorders, 1997-2002 and 2003-2008 _____	29
Table 10	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Pain, 1997-2002 and 2003-2008 _____	32
Table 11	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Regenerative Medicine, 1997-2002 and 2003-2008 _____	35
Table 12	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Nanomedicine, 1997-2002 and 2003-2008 _____	38
Table 13	Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Epigenetics, 1997-2002 and 2003-2008 _____	41

INTRODUCTION

In 2000, the Canadian Institutes of Health Research (CIHR) was created by the Canadian federal government to replace the Medical Research Council (MRC) as the premier research agency for health research in the country.¹

The Institute of Neurosciences, Mental Health and Addiction (INMHA) is one of the thirteen virtual institutes under the umbrella of CIHR. The mandate of INMHA is to support research that enhances knowledge of the brain – including mental health, neurological health, vision, hearing and other sensory systems, as well as cognitive sciences, spinal cord, and motor systems. The goal is to improve our understanding of human thought and emotion, behaviour, sensation, perception, learning, and memory. The hope is to reduce the burden of brain illness through prevention strategies, screening, diagnosis, treatment, support system and palliation.²

In addition to supporting research within its mandate, INMHA has co-led a number of cross-CIHR Strategic Initiatives. The goal of these initiatives is to support developing areas of health research that span the mandates of all of CIHR. Since 2003, the Regenerative Medicine and Nanomedicine Initiative (RMNI) has been providing funds for research into regenerative health approaches (including stem cells, tissue engineering, rehabilitation sciences, etc) and new and emerging technologies (i.e. Nanomedicine – nanotechnology applied to health, novel drug delivery approaches, etc.). More recently, under INMHA leadership, a Canadian Epigenetics, Environment and Health Research Network (CEEHRN) Initiative has been developed in partnership with many of the other CIHR Institutes.

This bibliometric report was commissioned by INMHA to analyze the scientific production of Canadian researchers within INMHA's main domains over the 1997-2008 period. A number of sub-domains of perceived research strength within INMHA's mandate are also examined. It is expected that these results will help inform INMHA's response to Second International Review of CIHR, and the renewal of INMHA's Strategic Plan. In addition, a number of cross-CIHR domains where INMHA has provided leadership have also been examined. These later domains are broader than just INMHA, and represent new and emerging areas of multi-disciplinary research for Canada. For all domains, this report compares the performance of Canadian researchers with that of researchers from other countries.

Throughout this report, domains are presented in the following order:

1. Neuroscience
 - a. Neuroimaging
 - b. Neural Stem Cells
2. Mental Health
3. Addiction
4. Senses and Communication Disorders
 - a. Pain
5. Regenerative Medicine
6. Nanomedicine
7. Epigenetics

Domains 1-4 represent the main domains of INMHA. Although overlap between domain 1 (Neuroscience) and the other main domains is unavoidable, care has been taken to clearly delineate search parameters among domains 2-4 (see Appendix 1). Sub-domains for a number of the main domains are indicated by the alphabetical sub-designations. In each case, these sub-domains represent a subset of the research of the larger domain they fall under.

Domains 5-7 represent areas of research that are broader than INMHA's mandate. These domains represent areas that span the mandate of CIHR, but where INMHA played a leading role in developing cross-cutting CIHR funding initiatives. It is also expected that INMHA-relevant researchers will play an important research role in these domains.

The first section of the report presents the methods and indicators used for compiling bibliometric data. The second section presents the evolution of Canada's scientific productivity, specialization and collaborative trends in each of the domains and sub-domains listed above. Finally, the last 5 sections compare Canada's productivity, specialization, scientific impact and collaboration with that of the 20 most productive countries of each of the 10 domains and sub-domains.

1 METHODS

1.1 Database

The bibliometric data presented here are drawn from the Canadian Bibliometric Database (CBD™) built by the *Observatoire des sciences et des technologies* (OST) using Thomson Reuters' Web of Science (WoS). The WoS includes three databases (the Science Citation Index Expanded™ [SCI Expanded], the Social Sciences Citation Index™, and the Arts & Humanities Citation Index™) covering, in 2008, more than 10,500 journals in all disciplines of knowledge. These databases do not include all documents likely to have been published by Canadian or foreign researchers, since some works are disseminated through other scientific media not indexed by the WoS (e.g., highly specialized journals, national journals, grey literature and particularly conference proceedings not published in journals). As such, the statistics presented here do not include all documents likely to have been published by Canadian or foreign researchers. What these statistics do measure, however, is the share of researchers' scientific output that is the most visible for Canadian and worldwide scientific communities, and therefore that is most likely to be cited.

Although OST's database includes several types of documents, only articles, research notes and review papers are typically selected in producing bibliometric studies as these are the primary means of disseminating new knowledge.

1.2 Retrieval of Papers in Each of the Domains

The OST's database uses a discipline classification developed by CHI Research and used by the National Science Foundation (NSF) in the U.S.³ The primary advantage of this classification over the one provided by the WoS is that it categorizes each journal exclusively within a single discipline, which prevents duplicate counting when the data are presented by discipline. Unfortunately, this classification scheme does not have any subject category for any of the 10 research domains analyzed in this report. Hence, to retrieve papers in these areas, we used the U.S. National Library of Medicine Medical Subject Headings (MeSH), which relies on a controlled vocabulary to assign a medical domain to each paper indexed in the PubMed database⁴. MeSH headings chosen by CIHR-INMHA for each of the 10 domains are presented in the Appendix 1. Table 1 presents, for each of the 10 domains, the percentage of papers retrieved from PubMed using each of the MeSH terms, as well as the number of these papers recalled in the WoS. In addition to these MeSH terms, we also retrieved all papers published in specific 'core' journal(s) of each of the domains—chosen by CIHR-INMHA. The only exception is Neuroimaging where no such journal(s) could be found. Appendix 2 presents this list of journals for each of the 10 research domains.

Table 1 Number of papers retrieved from PubMed and number and percentage of these papers recalled in the Web of Science

Domain	Papers retrieved from PubMed	Subset published in WoS-indexed journals	N. papers matched	% papers matched
Neuroscience	1 184 304	1 065 895	961 172	90,2%
Neuroimaging	223 751	207 635	190 413	91,7%
Neural Stem Cells	12 915	12 215	11 655	95,4%
Mental Health	275 936	242 564	215 383	88,8%
Addiction	77 290	66 902	59 339	88,7%
Senses	148 640	129 106	111 159	86,1%
Pain	113 953	97 534	81 742	83,8%
Regenerative Medicine	44 333	39 137	35 140	89,8%
Nanomedicine	31 692	29 511	27 516	93,2%
Epigenetics	35 084	32 795	30 972	94,4%

Many of these papers belong to more than one research domain (Table 2). As expected, the domain of Neuroscience has a high degree of overlap with the other main INMHA domains, with a large number of papers in the domains of Mental Health (88.8%), Addiction (76.2%) and the Senses and Communication Disorders (51.1%) also belonging to Neuroscience. Of course, Neuroscience is broader than any of the other domains, with only 5-20% of total Neuroscience papers captured to any one specific domain. These results are explained by the very broad MeSH search terms used for the Neuroscience domain compared to the narrower search terms for the other main domains (Appendix 1).

Where possible, overlap has been minimized among the main INMHA domains. For example, only 10.9% of Addictions papers also belong to Mental Health in this analysis. These results are explained by the mutually exclusive assignment of journals and MeSH search terms among the other main domains (see Appendices 1 & 2).

The INMHA sub-domains of Neuroimaging, Neural Stem Cells, and Pain are subsets of their parent main domains. As such, typically 100% of these papers belong to a main INMHA domain. Note that Neural Stem Cells refers to all papers that overlap the domains of Stem Cells and Neuroscience (Appendix 1).

The cross-CIHR domains of Regenerative Medicine, Nanomedicine and Epigenetics are broader than INMHA's mandate, and thus show little overlap to specific INMHA domains. However, both Epigenetics and Regenerative Medicine have measurable overlap with Neuroscience (10-12%), indicating the relative importance of Neuroscience to these fields. Note that Regenerative Medicine does not include all stem cell papers – only those that pertain to regenerative therapies (Appendix 2).

Table 2 Overlap between the each of the domains

Domain	Neural		Neural	Mental	Addict	Senses	Pain	Reg		Epi.	All
	Neuro.	Imag	SC	Health				Med	Nano		
Neuroscience		19,5%	1,2%	20,4%	4,9%	10,3%	5,8%	0,5%	0,1%	0,3%	100%
Neuroimaging	100,0%		0,5%	13,3%	1,4%	14,1%	10,2%	0,3%	0,1%	0,1%	100%
Neural Stem Cells	100,0%	8,9%		4,0%	0,4%	1,9%	0,5%	20,9%	0,4%	1,8%	100%
Mental Health	88,8%	11,2%	0,2%		3,1%	2,8%	1,8%	0,1%	0,02%	0,2%	100%
Addiction	76,2%	4,4%	0,1%	10,9%		2,3%	1,6%	0,03%	0,01%	0,1%	100%
Senses	51,1%	13,6%	0,1%	3,2%	0,7%		43,3%	0,2%	0,0%	0,1%	100%
Pain	66,5%	22,6%	0,1%	4,8%	1,1%	99,9%		0,2%	0,01%	0,02%	100%
Regenerative Med.	12,1%	1,3%	6,2%	0,5%	0,05%	1,2%	0,4%		1,6%	1,2%	100%
Nanomedicine	2,5%	0,8%	0,1%	0,1%	0,02%	0,2%	0,04%	2,2%		0,3%	100%
Epigenetics	10,0%	0,6%	0,7%	1,7%	0,2%	0,5%	0,1%	1,5%	0,2%		100%

1.3 Indicators

Number of publications: The number of scientific papers with authors from a country, as found in authors' addresses. It should be noted that data for 2008 are incomplete because some journals published in 2008 were only indexed in by Thomson Reuters in 2009 and, hence, are not yet included in the current version of the CBD. This underestimates the global scientific production by a percentage between 5% and 10%. These *not yet indexed* publications, however, only have a marginal effect on statistics presented in this report, as most of the data are grouped into 6-year periods. Moreover, our experience shows that these publications are evenly distributed across disciplines and countries and, hence, do not affect the comparisons made in this report.

Average of Relative Citations (ARC): This indicator is based on the number of citations received by papers over a two-year period following publication year. Thus, for papers published in 2000, citations received between 2000 and 2002 are counted. This means that citations counts for papers published between 2007 and 2008 are incomplete. First author self-citations are excluded. The number of citations received by each paper is normalized by the average number of citations received by all papers of the same specialty—as defined by US National Science Foundation classification of journals⁵—hence taking into account the fact that citations practices are different for each specialty. When the ARC is greater than 1, it means that a paper or a group of papers scores better than the world average of its specialty; when it is below 1, those publications are not cited as often as the world average.

Given that the dataset of papers used in this study does not comprise all papers published in each of the NSF specialty of the database but, rather, a subset of the papers of some of these specialties which were retrieved using a MeSH term / journal approach, the world average for a given domain might not be equal to 1. Indeed, the normalization of citations per paper is performed at the level of the complete database using the NSF classification, for all papers of all specialties, irrespective of their retrieval in the study. Hence, the subset of papers retrieved in a specialty (e.g. cancer, cell biology, etc.) for a given domain (Addiction, Nanomedicine, etc.) might have citation characteristics that are different from those of all papers of the specialty, resulting in a 'world average' that can be above or below 1. In other words, world averages presented in the figures represent the average scientific impact of each domain relative to that of all papers published in the same specialty.

Average relative impact factor (ARIF): This indicator provides a measure of the scientific impact of the journals in which a country publishes. Each journal has an impact factor (IF), which is calculated annually based on the number of citations it receives relative to the number of papers it publishes. The value of a journal's IF is assigned to each paper it publishes. In order to account for different citation patterns across disciplines and specialities (e.g., there are more citations in biomedical research than mathematics), each paper's IF is then divided by the average IF of the papers in its particular speciality in order to obtain a Relative Impact Factor (RIF). The ARIF of a given country is computed using the average RIF of all papers belonging to it. When the ARIF is greater than 1, it means that that country's researchers score better than the world average; when it is below 1, they publish in journals that are not cited as often as the world average. In a manner similar to the ARC, the ARIF's world average can be below or above 1, depending on the domain's average impact per paper compared to that of its parent sub-field.

Specialization index (SI): This is an indicator of the intensity of publication of a country in a specific domain (stem cells, Neuroscience, etc.) relative to the intensity of the world in the same domain. A SI value above 1 means that a given group of researchers is specialized compared to the world average, while an index value below 1 means the opposite.

International collaboration rate: This is an indicator of the relative intensity of scientific collaboration between countries. The rate is calculated by dividing the number of papers with at least one author with a foreign country address by the country's total number of papers. A country's international collaboration rate is generally determined by its size, i.e. larger countries collaborate less than smaller ones. Hence, if Canada's international collaboration rate is greater than that of countries with a smaller research output, we can conclude that Canada is having stronger international partnerships than expected.

Inter-institutional collaboration rate: This is an indicator of the relative intensity of scientific collaboration between institutions. The rate is calculated by dividing the number of papers with at least two institutions by the entity's (e.g. country, state, province) total number of papers.

Network analysis: In order to visualize the collaborative ties between institutions active in the ten research domains a network analysis was performed using UCINET⁶⁷ (Borgatti, Everett and Freeman, 2002) and Netdraw⁸ (Borgatti, 2002) softwares. These softwares allow the creation of 2-dimensional networks of co-authored papers. The size of the edges (lines) between each of the nodes is determined by the number of co-authored papers between the two entities. A threshold of numbers of papers written in collaboration is fixed in each of the figures in order for the network to be clearer. Nodes representing Canadian institutions are in dark blue and nodes representing foreign organizations are in light grey.

In addition to the graphical representation of the network, institutions' degree centrality (Freeman, 1979) was compiled in order to assess their individual importance in the network. The degree centrality is the sum of all edges (links) pointing to a node. Thus, in the case of inter-institutional collaboration, the degree centrality is the sum of all institutions with which a given institution has published.

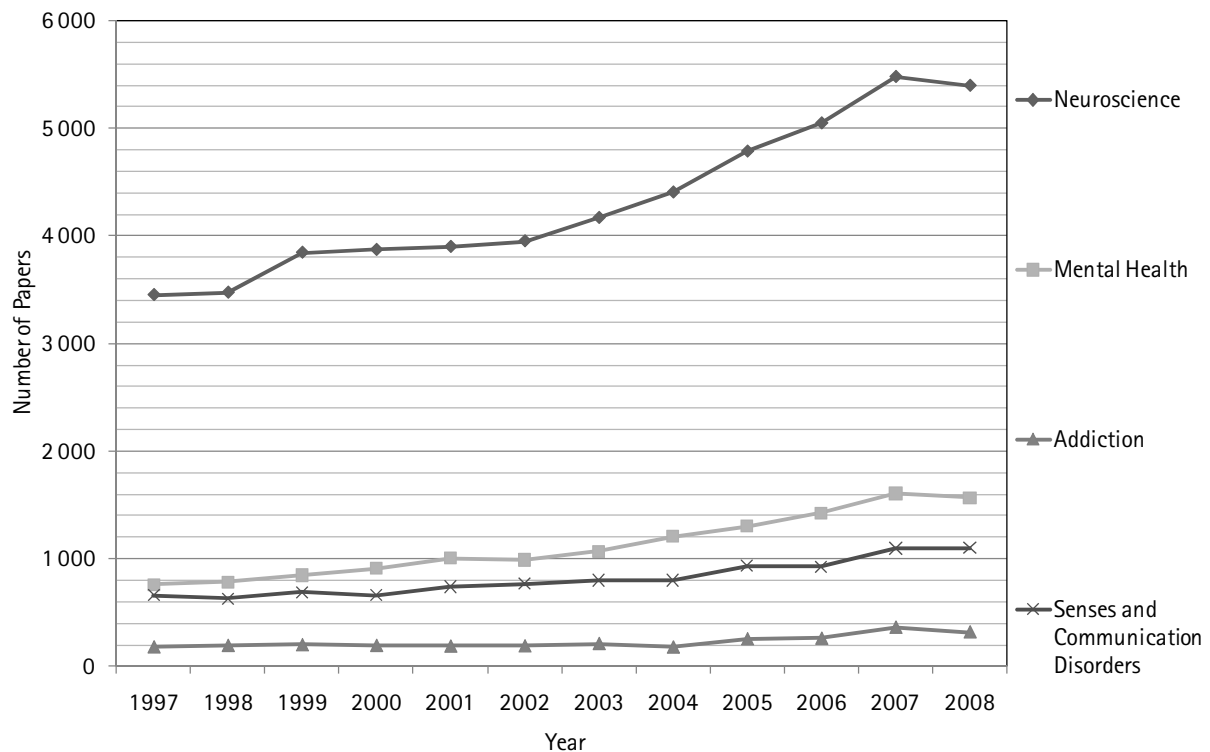
2 GLOBAL TRENDS

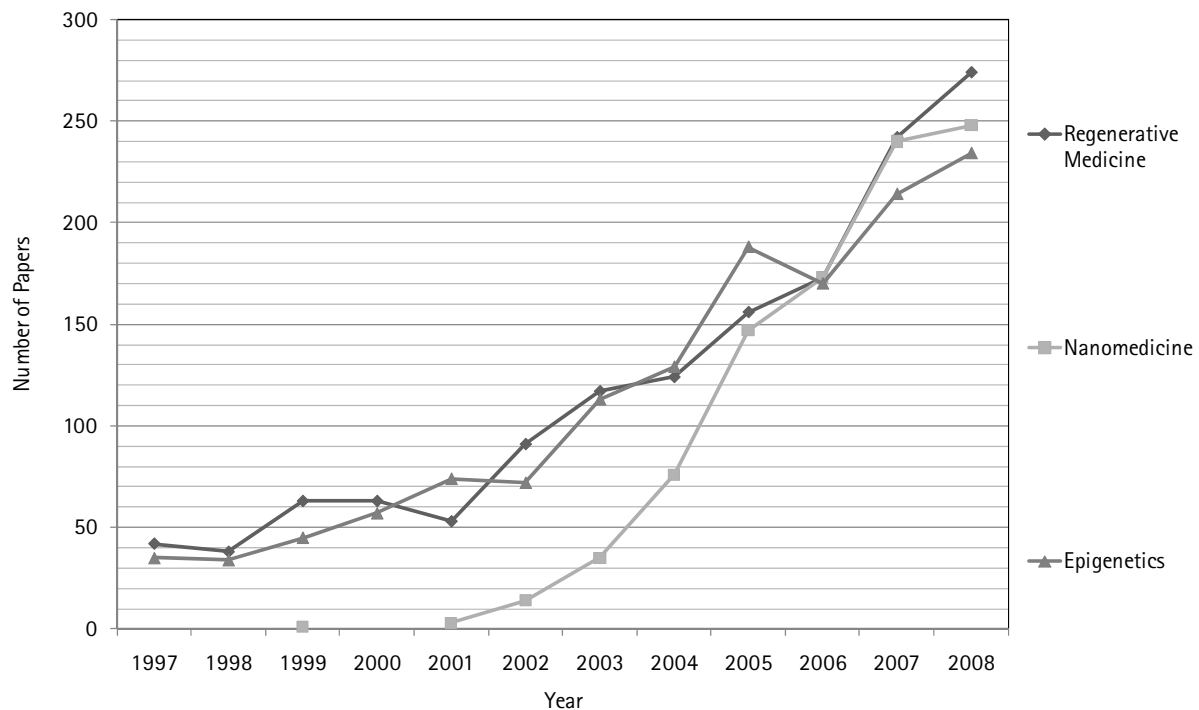
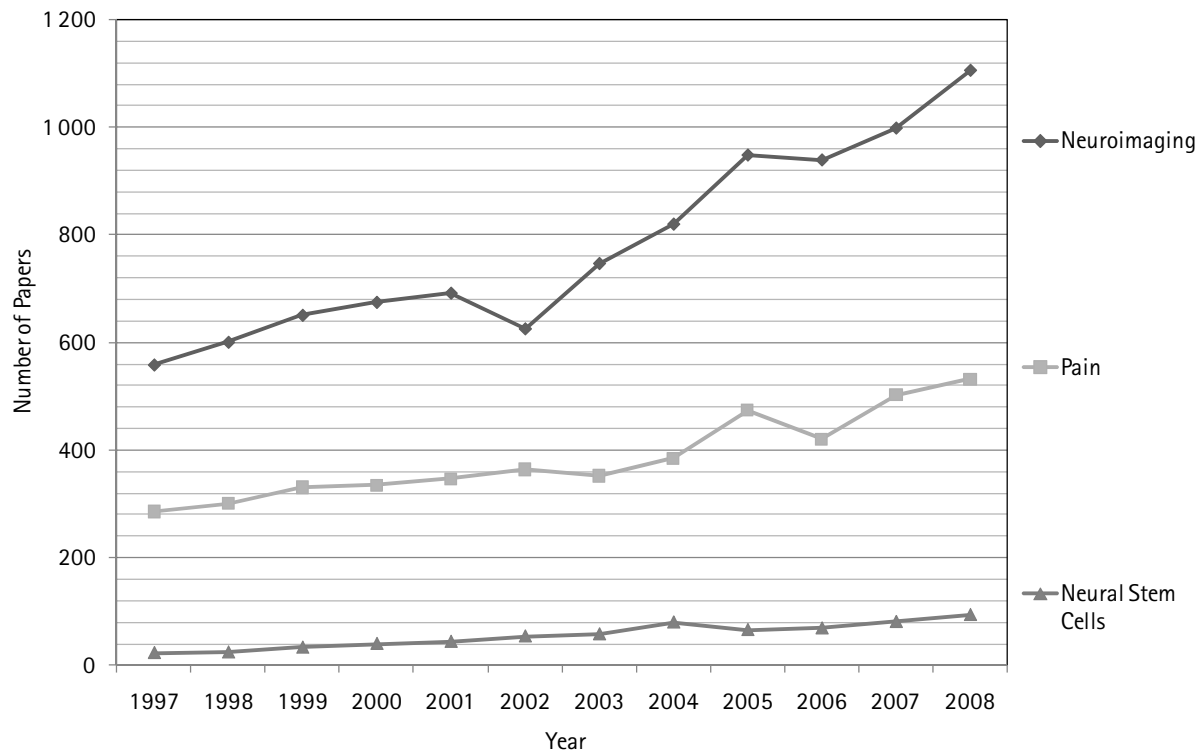
2.1 Number of Publications

Figure 1 presents the evolution of Canadian publications between 1997 and 2008, by domain. Data is presented on a logarithmic scale, as the number of Canadian (and world) publications varies significantly across these domains. The largest domain is by far Neuroscience with 5,481 publications authored by Canadian researchers in 2007 (data for 2008 is incomplete). The second largest is Mental Health with 1,606 publications, followed by Senses and Communication Disorders (1,096), Neuroimaging (998), Pain (503), Addiction (360), Regenerative Medicine (242), Nanomedicine (240), Epigenetics (214) and Neural Stem Cells (81). For all domains, the annual number of publications is on the rise. Not surprising, the fastest growing domains were the smallest ones. Indeed, while the growth rate for the 1997-2008 period is between 50% and 100% for the first six domains, it is above 500% for Regenerative Medicine, Epigenetics and Neural Stem Cells. Nanomedicine appeared as an emerging domain in Canada, with only one publication prior to 2000 to a yearly output of about 250 at the end of the period studied.

Note that the apparent drop in output in 2008 for some domains is due to an incomplete publication data set for that year and should not be interpreted as a relative drop in output.

Figure 1 Number of canadian papers, by domain, 1997-2008



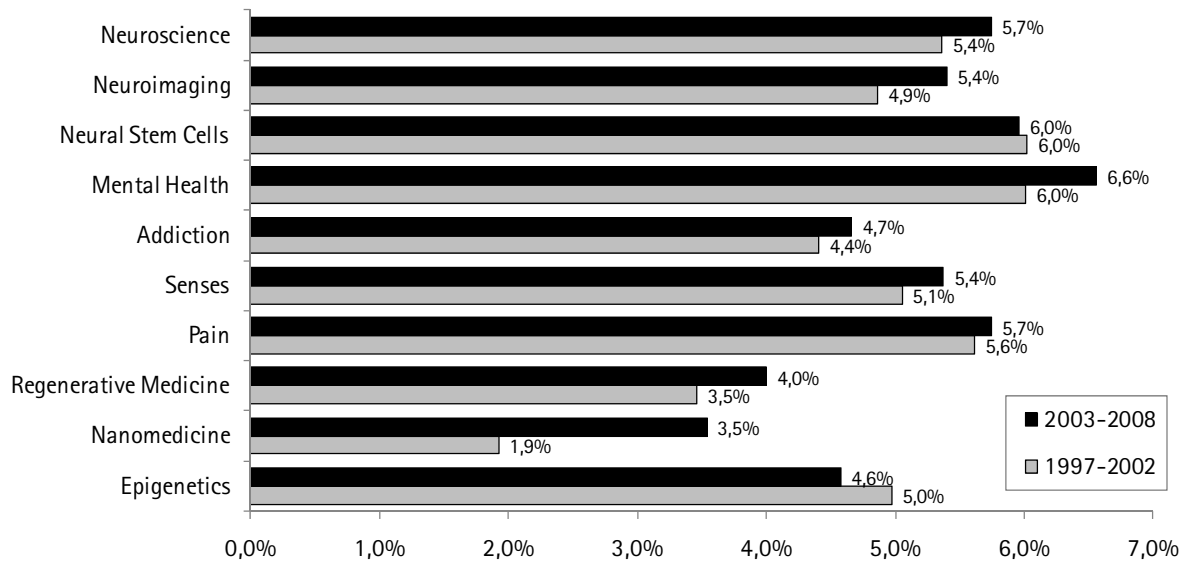


Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

In each of the domains under study, the proportion of world's papers authored by Canadian researchers varies over time. Figure 2 shows that, between 1997-2002 and 2003-2008, Canada increased its share of the world's papers in each of the domains but Neural Stem Cells and Epigenetics. For all disciplines

combined, Canadian authors contributed to 4.4% of all publications in 1997-2002 and to 4.6% in 2003-2008. Figure 22 shows that their contribution to the world's output is above these percentages in 8 of the 10 domains under study: Mental Health, Neural Stem Cells, Pain, Neuroscience, Neuroimaging, Senses and Communication Disorders and Addiction.

Figure 2 Canadian papers' percentage of world papers, by domain, 1997-2002 and 2003-2008



Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

For most disciplines covered in the WoS, Canada's rank in terms of numbers of papers was relatively unchanged between 1997-2002 and 2003-2008 (Table 3). Canada improved its ranking in Neuroscience (from 6th to 5th position), Pain (from 5th to 4th) and Nanomedicine (from 14th to 8th). It maintained its relative position in the other domains, except in Epigenetics where it dropped slightly (from 6th to 7th).

Table 3 Canada's world rank in terms of number of papers, by domain, 1997-2002 and 2003-2008

Domain	1997-2002	2003-2008
Neuroscience	6	5
Neuroimaging	7	7
Neural Stem Cells	6	6
Mental Health	4	4
Addiction	5	5
Senses	5	5
Pain	5	4
Regenerative Medicine	8	8
Nanomedicine	14	8
Epigenetics	6	7

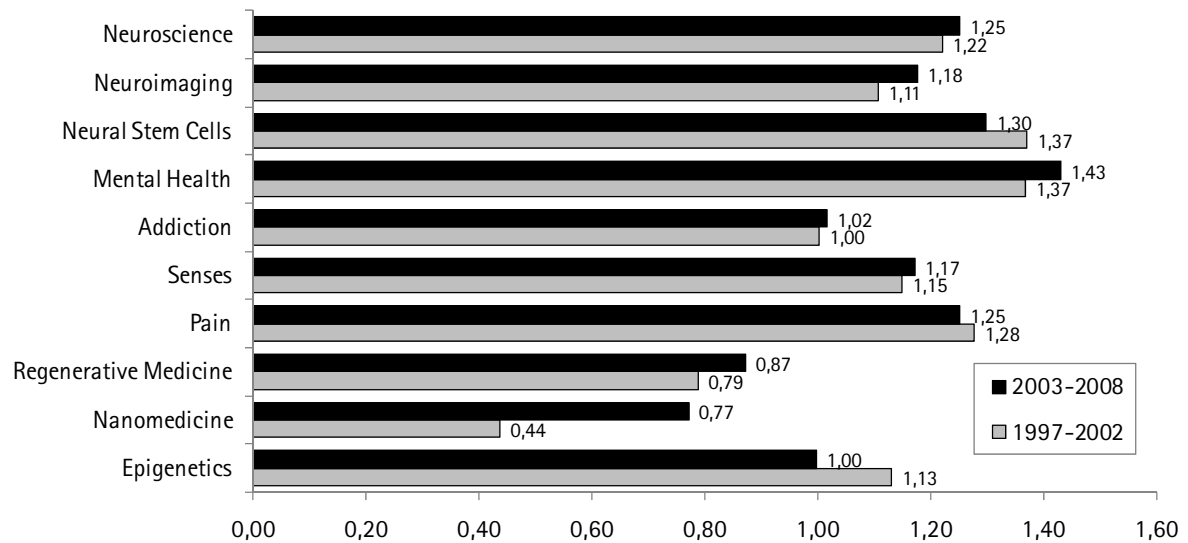
Source : Observatoire des sciences et des technologies (SCI

Expanded, SSCI and AHCI and Medline databases) - July 2009 update

2.2 Specialization

Figure 3 presents Canada's specialization index in each of the ten domains. It shows that Canada specialized in 7 of the 10 domains and more particularly in Mental Health (1.43 for 2003-2008), Neural Stem Cells (1.30), Pain (1.25) and Neuroscience (1.25). Between 1997-2002 and 2003-2008, Canada increased its specialization in seven domains.

Figure 3 Canada's specialization index, by domain, 1997-2002 and 2003-2008

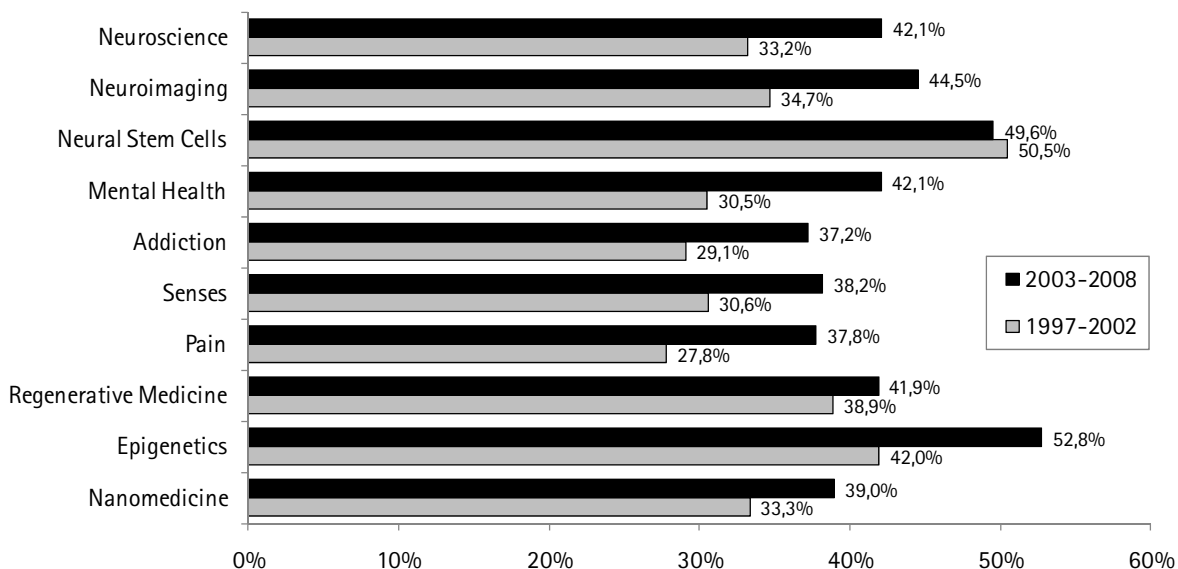


Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

2.3 Collaboration

Figure 4 shows that the percentage of Canadian publications co-authored with foreign researchers increased in all domains over the period, except in Neural Stem Cells where it remained stabled at about 50%. It should be noted, however, that the international collaboration rate of papers in this area was by far the highest among all domains in 1997-2002 and that it held the second place in 2003-2008, just behind Epigenetics. Between 1997-2002 and 2003-2008, international collaboration increased by 10 percentage points or more in three domains: Epigenetics (42.0% to 52.8%), Mental Health (30.5% to 42.1%) and Neuroimaging (from 34.7% to 44.5%). During the 2003-2008 period, between 40% and 50% of Canadian papers in Mental Health, Neuroimaging, Neural Stem Cells, Neuroscience and Regenerative Medicine were authored with foreign partners. This percentage was below 40% in Addiction, Nanomedicine, Pain and Senses and Communication Disorders.

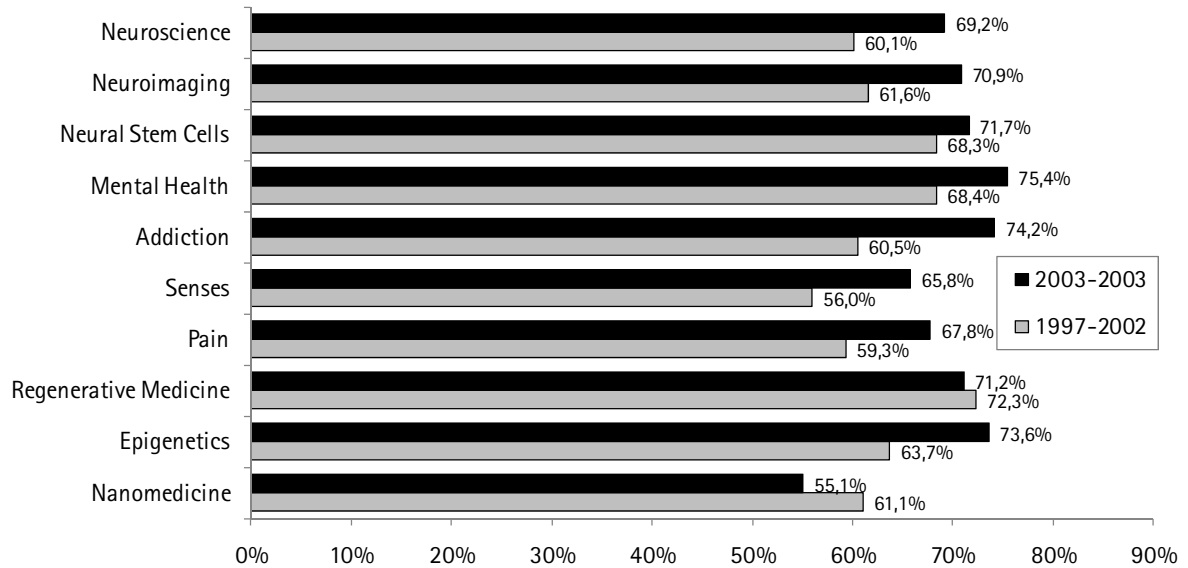
Figure 4 International collaboration rate of Canadian papers, by domain, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 5 provides evidence that inter-institutional collaboration rates increased between 1997-2002 and 2003-2008 in most domains. In six research domains, more than 70% of Canadian publications published between 2003 and 2008 are co-authored by researchers from different institutions. These domains are Mental Health (75.4%), Addiction (74.2%), Epigenetics (73.6%), Neural Stem Cells (71.7%), Regenerative Medicine (71.2%) and Neuroimaging (70.9%). Networks of inter-institutional collaboration presented in sections 3 to 7 will show the Canadian and foreign institutions involved in such collaborations.

Figure 5 Inter-institutional collaboration rate of Canadian papers, by domain, 1997-2002 and 2003-2008



Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

The five following sections (3 to 7) examine, for each of the domains and sub-domains, Canada's position among the top 20 most productive countries. In addition to the number of publications, specialization indexes, average of relative citations and average of relative impact factor are presented for two time periods: 1997-2002 and 2003-2008. For each research domain, a scatter plot also presents the relative position of countries regarding the specialization index, the average of relative citations and the number of papers for the 1997-2002 and 2003-2008 periods. Finally, networks of inter-institutional collaboration are presented and the most central institutions—as measured by their degree centrality (Freeman, 1979)—are highlighted.

3 NEUROSCIENCE

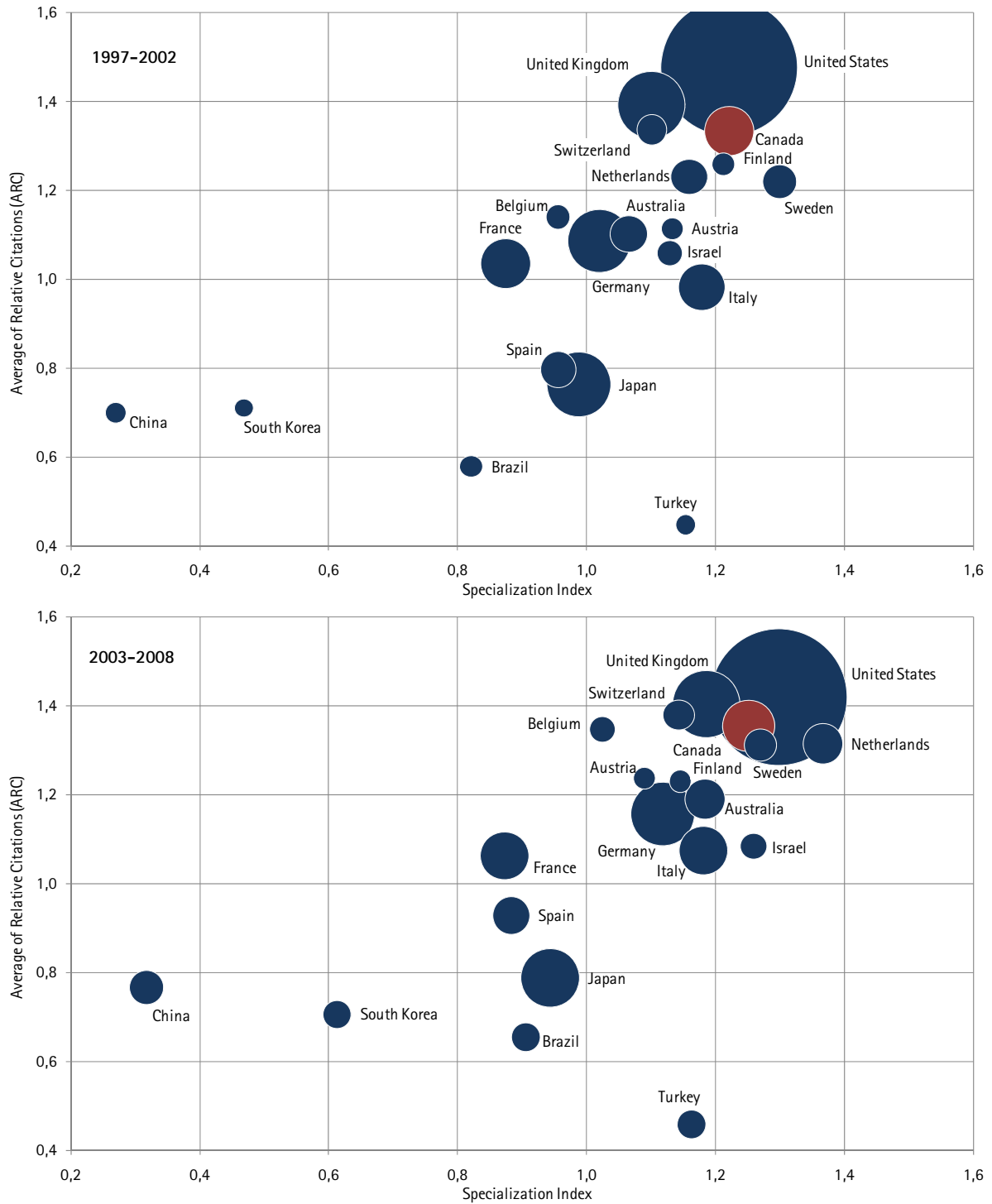
With an increase of 30% of its research output in Neuroscience between 1997-2002 and 2003-2008, Canada moved from the sixth to the fifth rank in number of publications, as its output surpassed that of France (Table 4). Its specialization index in this domain has also slightly increased from 1.22 to 1.25 between 1997-2002 and 2003-2008, placing Canada in the fourth rank among the 20 most productive countries. More significantly, Canadian researchers' scientific impact is well above world average both in terms of citations received (ARC) and journal impact (ARIF), with Canada ranking fourth for ARC and fifth for ARIF in 2003-2008 (see also Figure 6). The international collaboration rate of Canadian researchers is mildly above that of researchers from countries of the same size. Given the high number of papers published in the domain, the network of inter-institutional collaboration is quite dense (Figure 7) and a high threshold had to be used (50 papers or more). The most central Canadian institutions in the network are, in decreasing order, the University of Toronto, University of British Columbia, McGill University, The Hospital for Sick Children, University of Calgary, University of Alberta, McMaster University and the Montreal Neurological Institute and Hospital.

Table 4 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neuroscience, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	SI	Collabo	ARC	ARIF	Papers	SI	Collabo	ARC	ARIF
United States	173 085	1,22	17,8%	1,48	1,29	207 593	1,30	23,4%	1,42	1,25
United Kingdom	41 782	1,10	29,3%	1,39	1,20	50 218	1,19	40,8%	1,40	1,21
Germany	36 936	1,02	30,4%	1,09	1,00	45 141	1,12	39,0%	1,16	1,03
Japan	37 962	0,99	16,3%	0,76	0,90	38 191	0,94	20,5%	0,79	0,92
Canada	22 485	1,22	33,2%	1,33	1,17	29 287	1,25	42,1%	1,36	1,17
Italy	20 102	1,18	30,9%	0,98	1,01	26 240	1,18	35,9%	1,07	1,02
France	23 051	0,87	31,5%	1,04	0,99	25 335	0,87	38,7%	1,06	1,01
Australia	12 332	1,07	26,7%	1,10	1,05	17 874	1,18	36,6%	1,19	1,08
Netherlands	11 992	1,16	36,2%	1,23	1,14	17 457	1,37	44,1%	1,31	1,19
Spain	11 552	0,95	25,4%	0,80	0,87	15 176	0,88	32,5%	0,93	0,92
China	3 956	0,27	34,5%	0,70	0,80	12 905	0,32	36,8%	0,77	0,89
Sweden	10 605	1,30	39,8%	1,22	1,07	11 537	1,27	48,2%	1,31	1,10
Switzerland	8 117	1,10	49,5%	1,34	1,15	10 523	1,14	60,2%	1,38	1,18
Brazil	4 572	0,82	28,3%	0,58	0,68	9 190	0,91	26,0%	0,65	0,76
Turkey	3 543	1,15	13,5%	0,45	0,61	9 156	1,16	12,2%	0,46	0,61
South Korea	3 303	0,47	26,1%	0,71	0,87	8 720	0,61	25,0%	0,71	0,86
Israel	5 864	1,13	32,2%	1,06	1,14	7 371	1,26	37,9%	1,08	1,09
Belgium	5 215	0,96	47,7%	1,14	1,01	7 286	1,02	55,6%	1,35	1,13
Austria	4 403	1,13	41,3%	1,11	0,95	5 290	1,09	52,6%	1,24	1,04
Finland	4 751	1,21	37,5%	1,26	1,13	5 221	1,14	45,4%	1,23	1,11
World	419 215	1,00	-	1,11	1,07	509 873	1,00	-	1,08	1,05

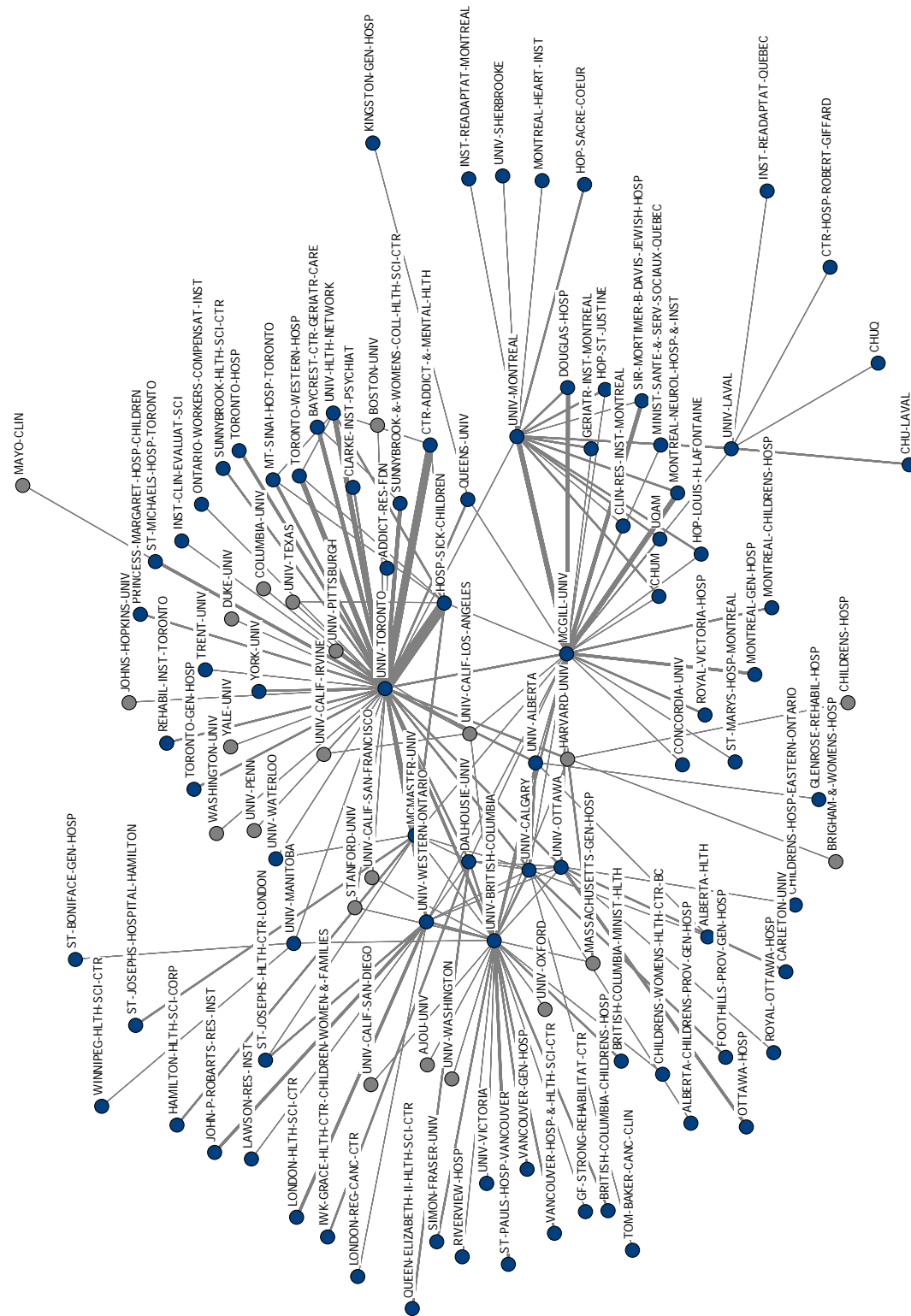
Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 6 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neuroscience, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 7 Network of collaboration of Canadian institutions in the domain of Neuroscience, 1997-2008 (50 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

3.1 Neuroimaging

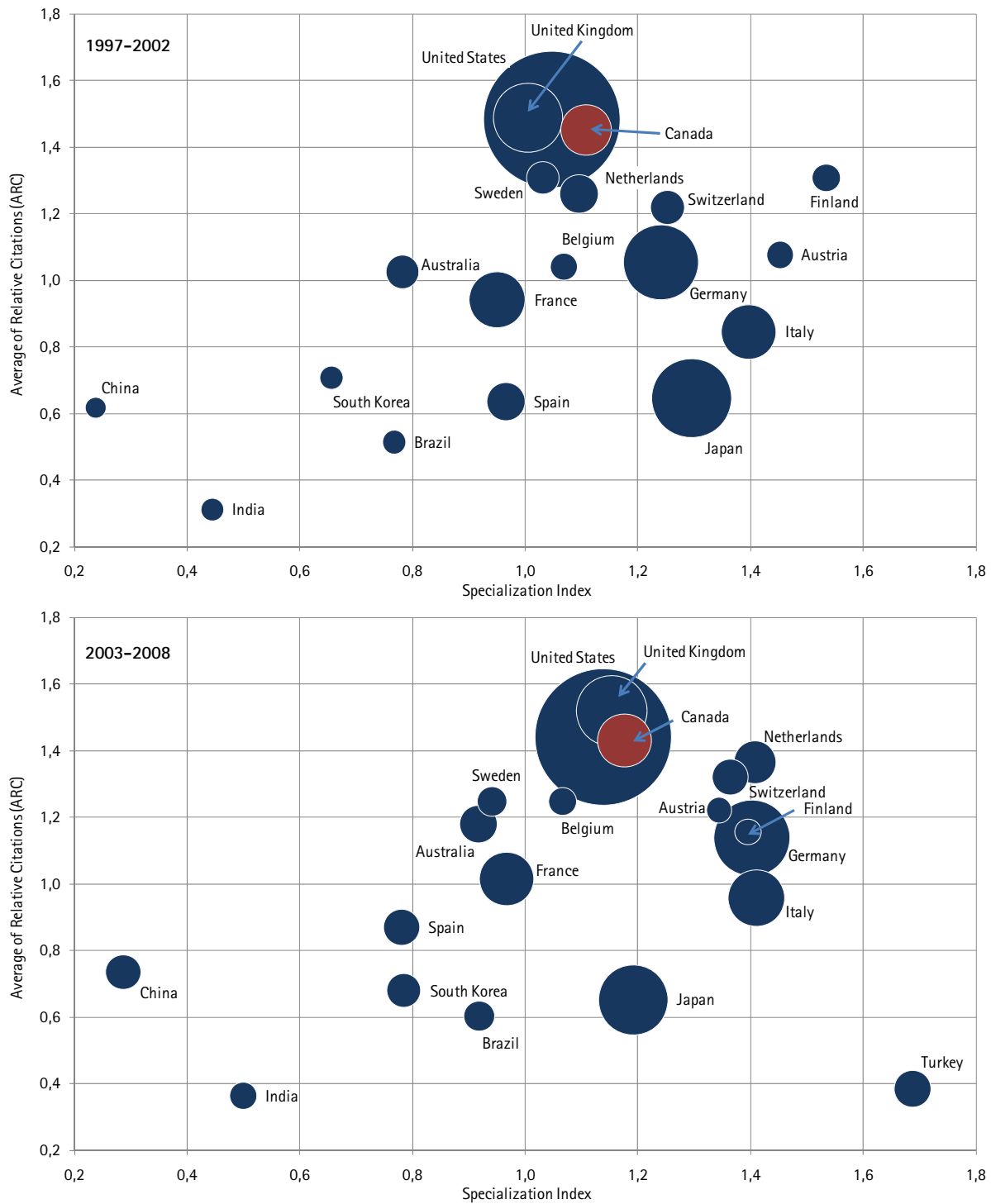
In terms of absolute number of papers, Canadian research in the field of Neuroimaging retained 7th place throughout the period (Table 5). However, its scientific impact remained well above the world average, and its specialization slightly increased from 1.11 to 1.18, between the two time periods. Among the 20 most productive countries, Canada ranks second—on a par with the United States—in terms of citations received (ARC) for the period 2003-2008, behind the United Kingdom. Other countries having relatively high impact and specialization – but lower ARC – between 2003 and 2008 are Germany, the Netherlands, Switzerland, Belgium, Austria and Finland (see also Figure 8). In terms of international collaboration, Canadian researchers are collaborating slightly more than their colleagues from countries of a similar size. The most central Canadian institutions are, in decreasing order of importance, University of Toronto, University of British Columbia, Montreal Neurological Institute and Hospital, McGill University and The Hospital for Sick Children (Figure 9).

Table 5 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neuroimaging, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	SI	% Internat Collabo	ARC	ARIF	Papers	SI	% Internat Collabo	ARC	ARIF
United States	27 705	1,05	18,1%	1,48	1,27	36 753	1,14	25,4%	1,44	1,26
Germany	8 380	1,24	27,5%	1,06	0,99	11 427	1,40	37,6%	1,14	1,07
United Kingdom	7 121	1,00	28,0%	1,49	1,21	9 860	1,15	41,8%	1,52	1,25
Japan	9 292	1,30	11,6%	0,65	0,82	9 740	1,19	15,8%	0,65	0,85
Italy	4 443	1,40	26,3%	0,85	0,85	6 323	1,41	32,9%	0,96	0,96
France	4 676	0,95	24,6%	0,94	0,87	5 665	0,97	34,8%	1,01	0,96
Canada	3 804	1,11	34,7%	1,45	1,22	5 557	1,18	44,5%	1,43	1,19
Netherlands	2 114	1,09	35,3%	1,26	1,12	3 630	1,41	44,6%	1,37	1,24
Australia	1 686	0,78	28,2%	1,03	1,05	2 795	0,92	40,7%	1,18	1,07
Spain	2 179	0,97	19,7%	0,63	0,74	2 706	0,78	31,0%	0,87	0,89
Turkey	1 198	2,09	9,8%	0,39	0,59	2 685	1,69	10,1%	0,39	0,62
Switzerland	1 722	1,25	43,8%	1,22	1,09	2 534	1,36	57,1%	1,32	1,15
China	650	0,24	34,2%	0,62	0,80	2 357	0,29	36,2%	0,73	0,89
South Korea	864	0,66	17,1%	0,71	0,84	2 255	0,78	20,3%	0,68	0,85
Brazil	796	0,77	23,9%	0,52	0,59	1 879	0,92	26,5%	0,60	0,68
Sweden	1 570	1,03	41,0%	1,31	1,10	1 726	0,94	51,4%	1,25	1,10
Belgium	1 087	1,07	37,6%	1,04	0,99	1 531	1,07	49,7%	1,25	1,08
India	771	0,44	7,3%	0,31	0,52	1 457	0,50	12,8%	0,36	0,59
Austria	1 052	1,45	31,4%	1,08	0,87	1 318	1,34	50,1%	1,22	1,04
Finland	1 123	1,53	34,9%	1,31	1,23	1 285	1,40	45,9%	1,16	1,10
World	78 207	1,00	-	1,05	1,01	102 947	1,00	-	1,04	1,03

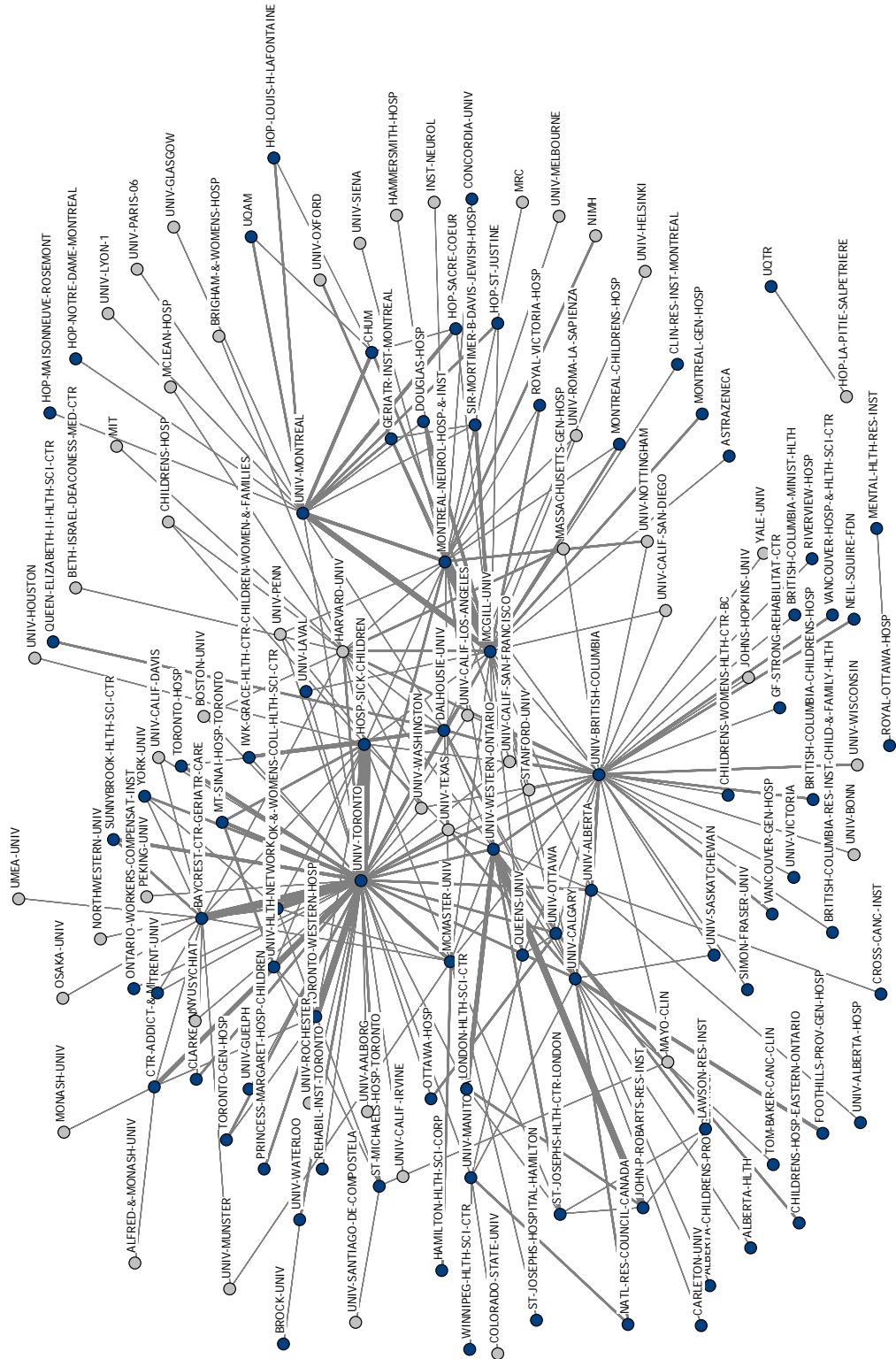
Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

Figure 8 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neuroimaging, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 9 Network of collaboration of Canadian institutions in the domain of Neuroimaging, 1997-2008 (10 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

3.2 Neural Stem Cells

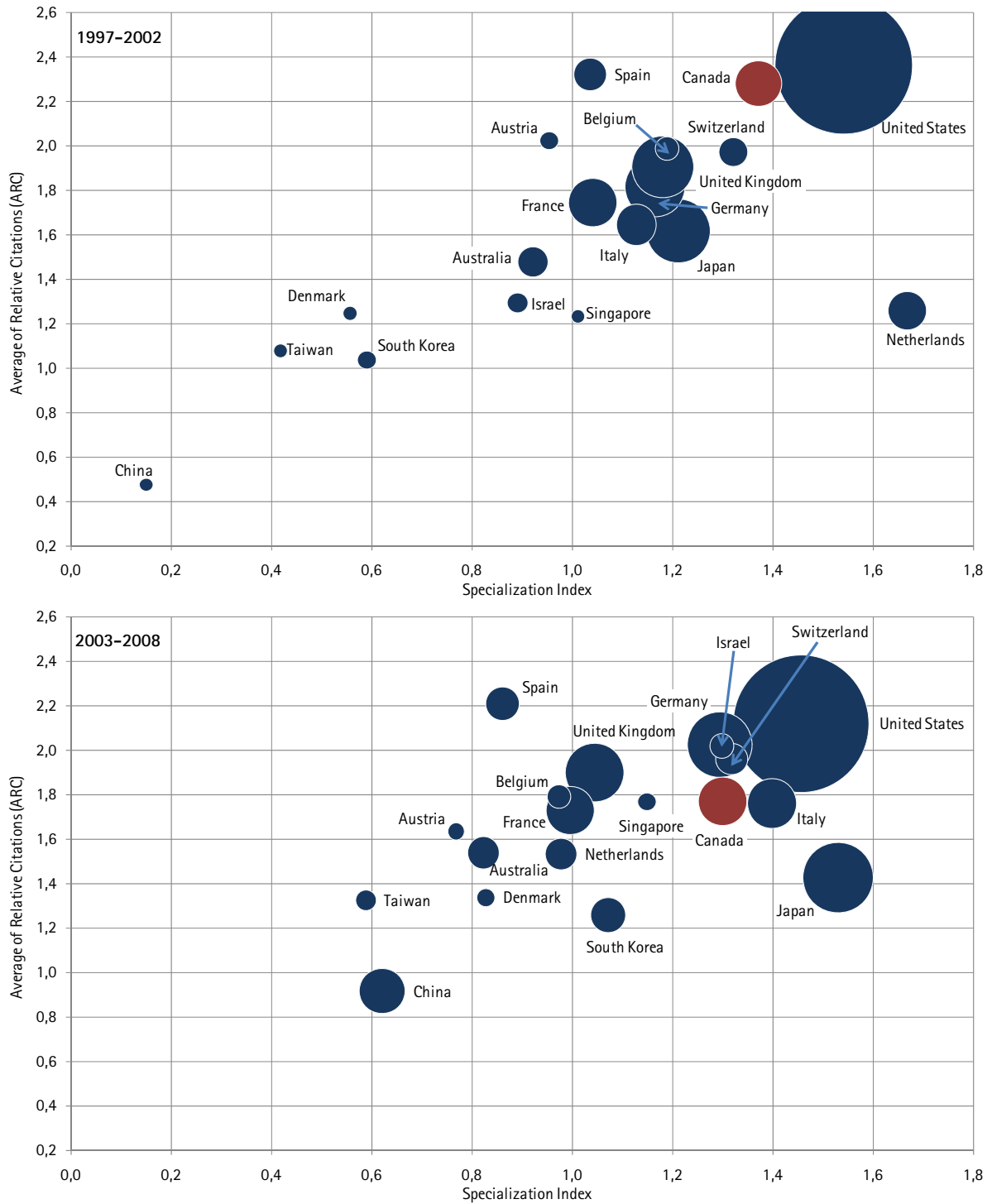
At the world level, the domain of Neural Stem Cells has increased by a factor of more than two between 1997-2002 and 2003-2008 (Table 6). Canada's publication rank (6th) remained unchanged during both time periods, although its specialization slightly decreased from 1.37 to 1.30. Its relative scientific impact (ARC) experienced a significant drop, from 2.28 to 1.77, however the world average has also decreased significantly from 1.94 to 1.70. As a consequence, Canadian researchers' scientific impact in Neural Stem Cells is now only slightly above the world average for the 2003-2008 period. During the same period, other countries with relatively high impact and specialization in this domain are the United States, Germany, United Kingdom, Italy, France, Israel and Switzerland (Figure 10). The table also shows that international collaboration activities of Canadian researchers are similar to those of comparable countries. The network of inter-institutional collaboration presented in Figure 11 shows that the most central Canadian institutions are University of Toronto, University of British Columbia, The Hospital for Sick Children and McGill University.

Table 6 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Neural Stem Cells, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	% Internat		ARC	ARIF	Papers	% Internat		ARC	ARIF
United States	1 888	1,54	27,4%	2,36	1,72	3 434	1,46	30,9%	2,12	1,53
Japan	402	1,21	30,1%	1,62	1,26	913	1,53	28,7%	1,43	1,18
Germany	364	1,16	55,2%	1,82	1,53	770	1,29	51,8%	2,03	1,48
United Kingdom	387	1,18	39,3%	1,90	1,61	652	1,04	47,4%	1,90	1,54
Italy	166	1,13	47,6%	1,65	1,28	458	1,40	40,4%	1,76	1,38
Canada	218	1,37	50,5%	2,28	1,50	448	1,30	49,6%	1,77	1,44
France	237	1,04	48,5%	1,74	1,65	426	1,00	56,1%	1,73	1,47
China	19	0,15	47,4%	0,47	0,90	373	0,62	37,8%	0,92	0,88
Sweden	133	1,89	58,6%	3,10	2,00	291	2,17	51,5%	1,62	1,40
South Korea	36	0,59	41,7%	1,03	1,14	225	1,07	39,6%	1,26	1,00
Spain	108	1,03	61,1%	2,32	1,48	218	0,86	52,8%	2,21	1,44
Netherlands	149	1,67	69,8%	1,26	1,29	184	0,98	65,8%	1,53	1,61
Australia	92	0,92	39,1%	1,48	1,39	183	0,82	49,2%	1,54	1,33
Switzerland	84	1,32	64,3%	1,97	1,65	179	1,32	67,6%	1,96	1,48
Israel	40	0,89	65,0%	1,29	1,67	112	1,30	51,8%	2,02	1,47
Belgium	56	1,19	67,9%	1,99	1,63	102	0,97	67,6%	1,79	1,40
Taiwan	19	0,42	36,8%	1,07	1,26	78	0,59	25,6%	1,32	1,16
Denmark	20	0,56	90,0%	1,25	1,11	60	0,83	73,3%	1,34	1,26
Singapore	16	1,01	43,8%	1,23	1,68	57	1,15	52,6%	1,77	1,33
Austria	32	0,95	65,6%	2,03	1,83	55	0,77	67,3%	1,63	1,58
World	3 618	1,00	-	1,94	1,52	7 517	1,00	-	1,70	1,34

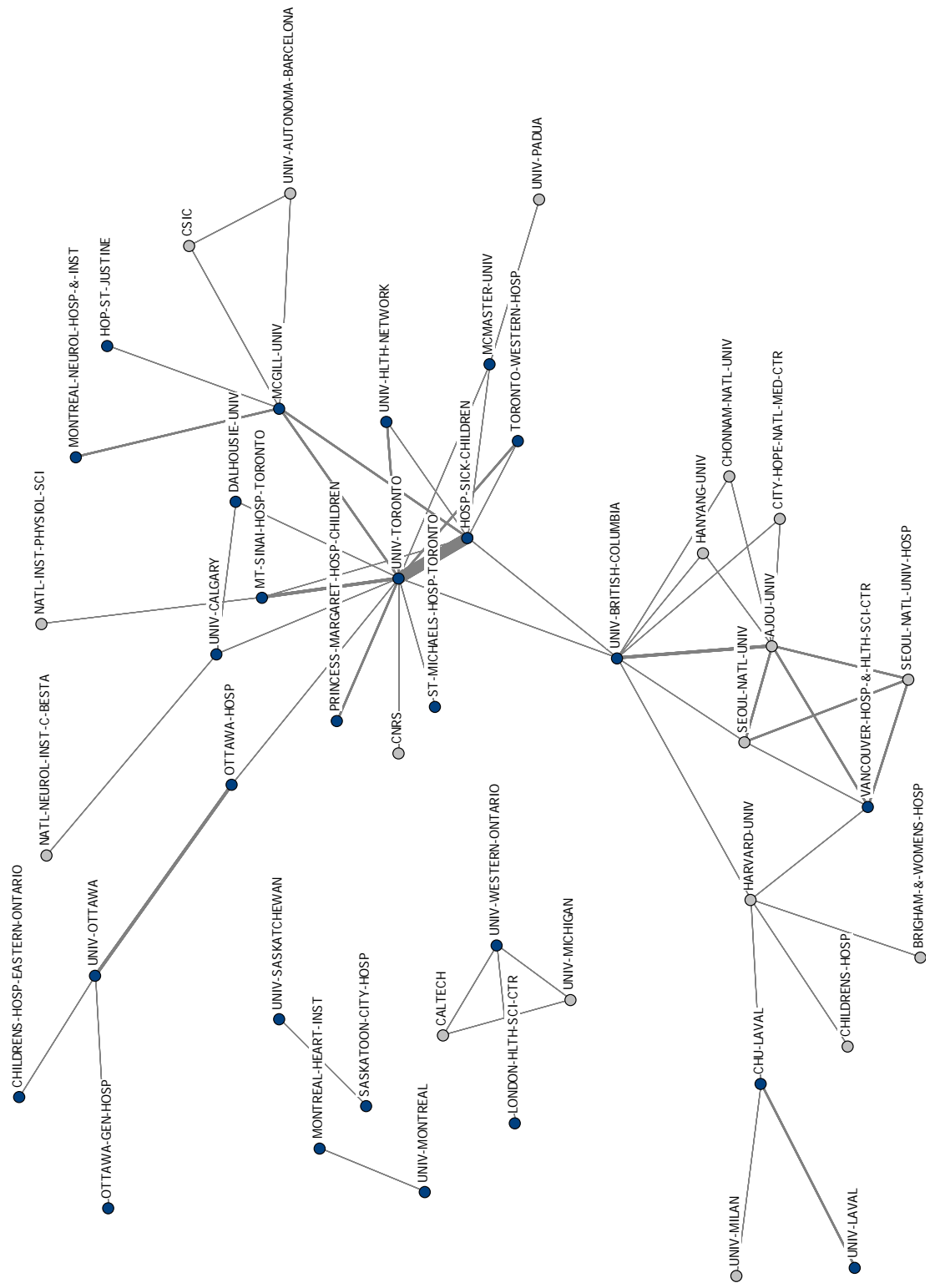
Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 10 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Neural Stem Cells, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 11 Network of collaboration of Canadian institutions in the domain of Neural Stem Cells, 1997-2008 (3 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

4 MENTAL HEALTH

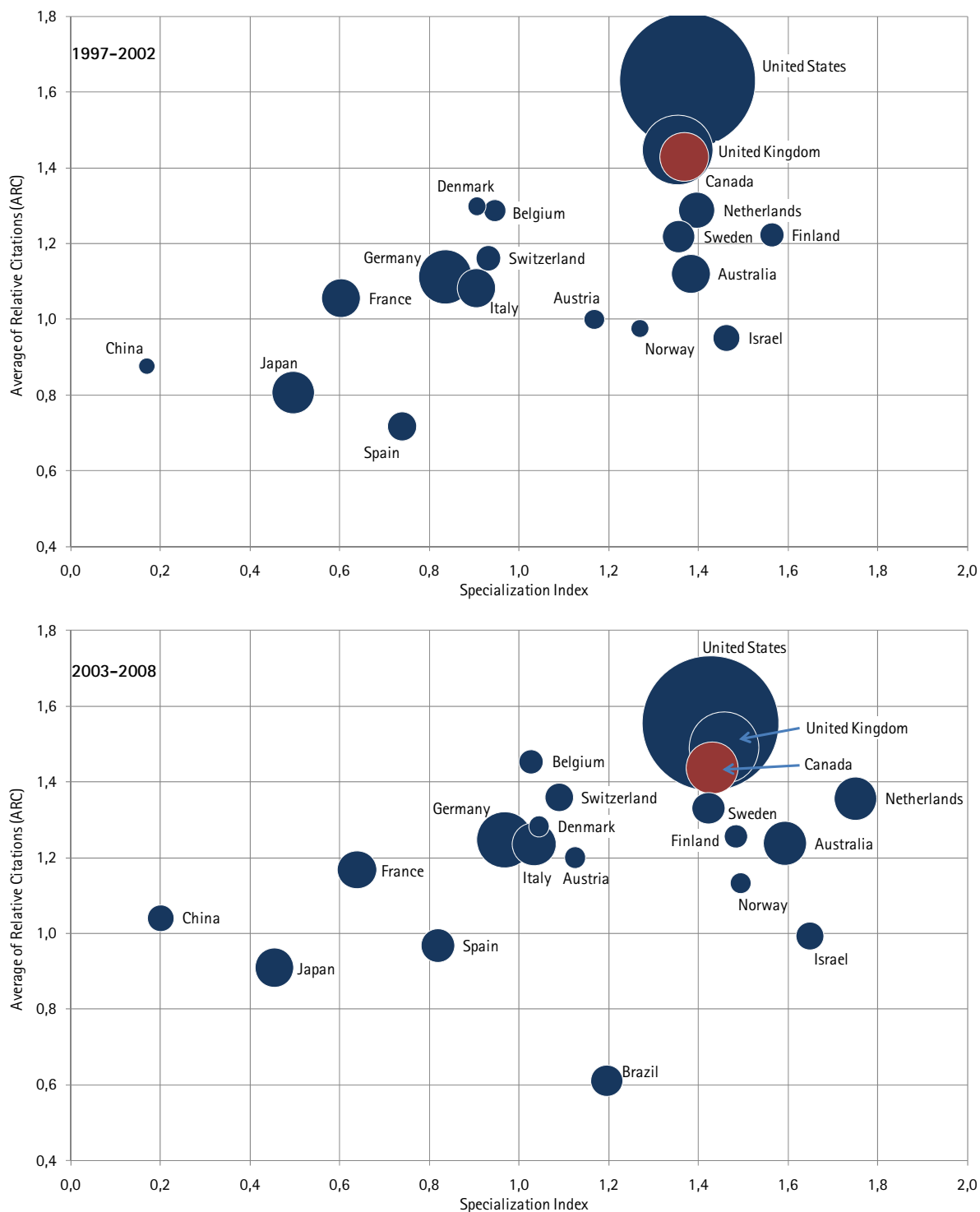
Mental Health is a domain where Canada is very active. For both time periods, it ranks fourth in terms of number of papers published, below the United States, the United Kingdom and Germany, but above countries with a larger population such as Italy, France and Japan (Table 7). Its specialization index in the domain also increased from 1.37 in 1997-2002 to 1.43 in 2003-2008. In terms of scientific impact, ARC and ARIF scores remained well above the world average during both time periods, with Canada ranking third – on par with Belgium – in ARC for 2003-2008, behind the United States and United Kingdom. In 2003-2008, other countries specialized in Mental Health with a scientific impact above average are the United States, the United Kingdom, Australia, the Netherlands, Switzerland, Belgium, Finland and Denmark (see also Figure 12). International collaborative ties of Canadian researchers are above those of countries with similar research output. Finally, the most central Canadian institutions in the network of collaboration (Figure 13) are University of Toronto, University of British Columbia, McGill University, Center for Addiction and Mental Health and McMaster University (in decreasing order).

Table 7 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Mental Health, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	SI	Collabo	ARC	ARIF	Papers	SI	Collabo	ARC	ARIF
United States	40 971	1,37	14,1%	1,63	1,32	55 845	1,43	21,2%	1,56	1,27
United Kingdom	10 807	1,35	24,7%	1,45	1,18	15 082	1,46	38,8%	1,49	1,21
Germany	6 348	0,83	26,2%	1,11	0,89	9 549	0,97	36,3%	1,25	0,97
Canada	5 294	1,37	30,5%	1,43	1,16	8 181	1,43	42,1%	1,44	1,17
Australia	3 359	1,38	24,1%	1,12	1,00	5 881	1,59	33,8%	1,24	1,11
Italy	3 241	0,90	32,8%	1,08	1,03	5 620	1,03	39,6%	1,23	1,05
Netherlands	3 033	1,40	32,4%	1,29	1,17	5 469	1,75	40,8%	1,36	1,19
France	3 333	0,60	28,9%	1,06	0,82	4 532	0,64	37,5%	1,17	0,90
Japan	4 003	0,50	19,5%	0,81	0,82	4 495	0,45	24,0%	0,91	0,93
Spain	1 877	0,74	22,9%	0,72	0,76	3 436	0,82	33,3%	0,97	0,87
Sweden	2 325	1,36	33,8%	1,22	1,03	3 162	1,42	44,2%	1,33	1,07
Brazil	1 480	1,26	17,4%	0,33	0,35	2 966	1,20	24,5%	0,61	0,57
Switzerland	1 441	0,93	45,2%	1,16	0,94	2 450	1,09	61,2%	1,36	1,12
Israel	1 596	1,46	24,2%	0,95	1,03	2 359	1,65	33,2%	0,99	1,03
China	527	0,17	44,4%	0,88	0,92	2 005	0,20	43,2%	1,04	1,02
Belgium	1 084	0,95	54,3%	1,29	0,97	1 786	1,03	60,8%	1,45	1,12
Finland	1 288	1,56	31,4%	1,22	1,10	1 654	1,48	41,6%	1,26	1,10
Austria	952	1,17	36,8%	1,00	0,82	1 337	1,13	49,2%	1,20	0,97
Norway	709	1,27	33,3%	0,98	0,90	1 316	1,49	43,4%	1,13	1,02
Denmark	792	0,91	36,5%	1,30	1,05	1 257	1,04	48,7%	1,28	1,16
World	88 058	1,00	-	1,25	1,09	124 675	1,00	-	1,21	1,08

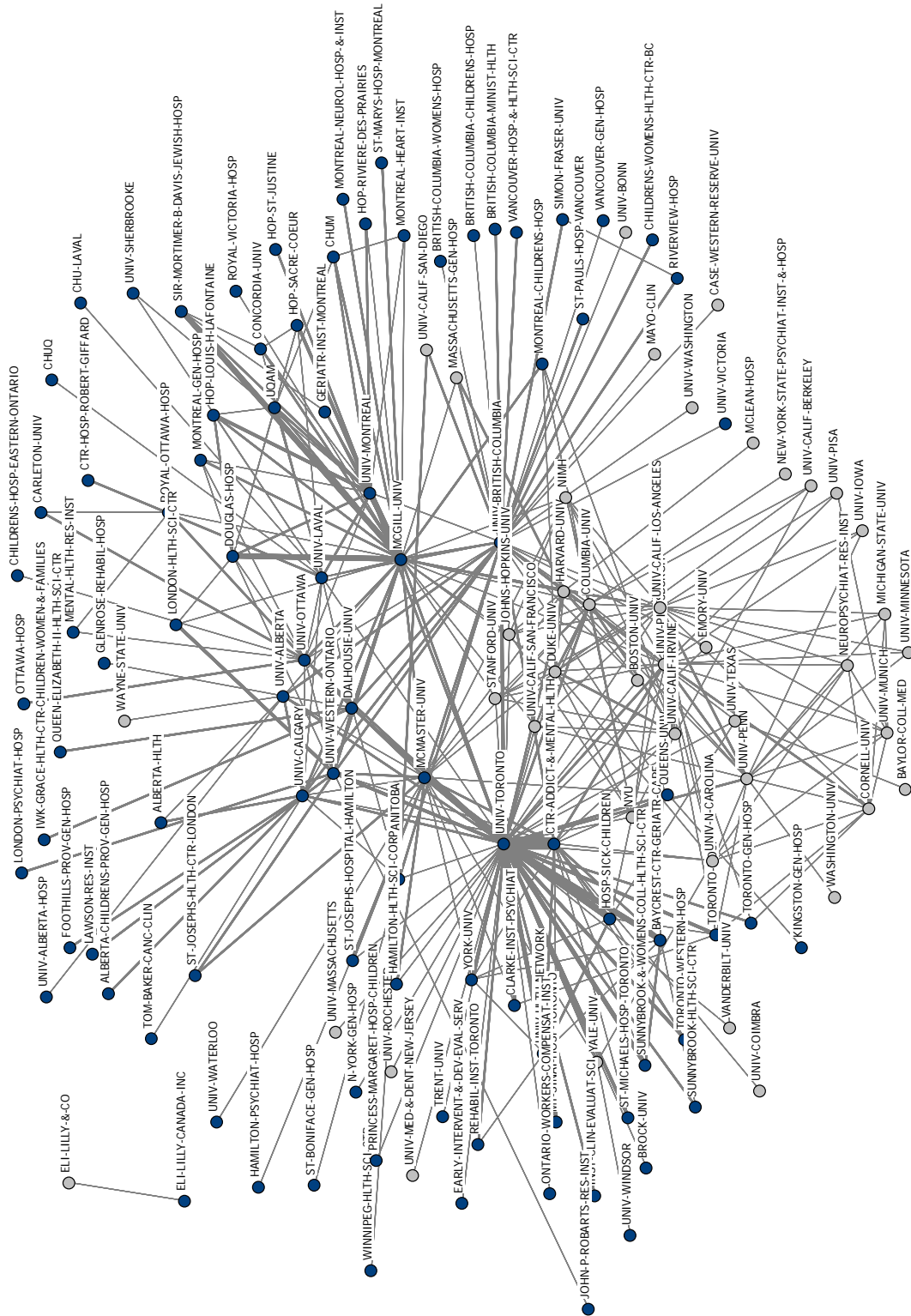
Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

Figure 12 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Mental Health, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 13 Network of collaboration of Canadian institutions in the domain of Mental Health, 1997-2008 (15 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

5 ADDICTION

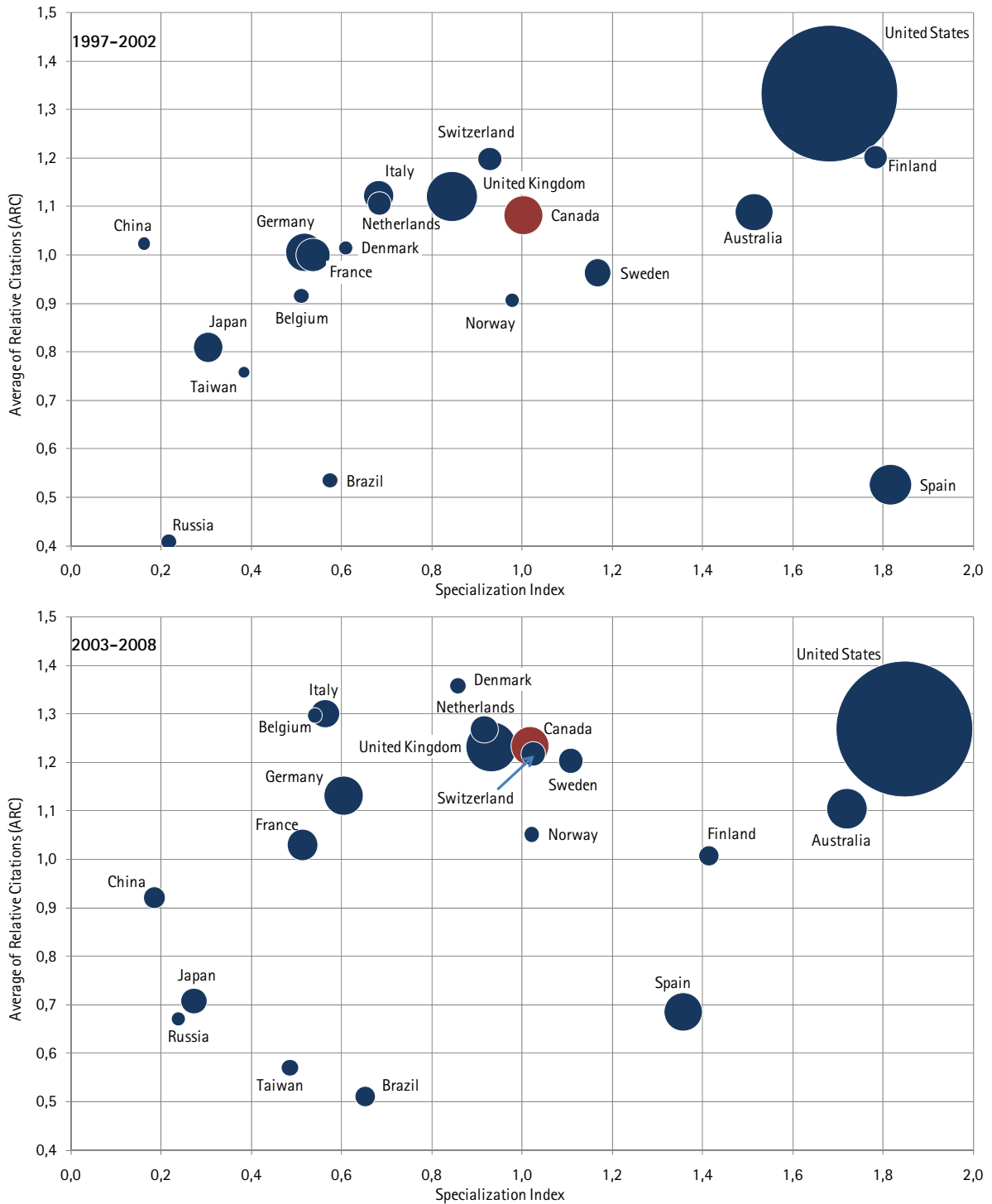
Table 8 shows that, for both time periods, Canada ranked fifth worldwide in terms of number of publications. Canada's specialization in Addiction research remained stable throughout the period, at around the world average. However, its scientific impact increased significantly, both in terms of journal impact (ARIF) and of citations received (ARC). More specifically, Canada went from being on a par with the world average to being among the top five countries with the highest scientific impact in 2003-2008. In 2003-2008, countries specialized in Addiction and having a scientific impact above average are the United States, Australia, Sweden and Switzerland (Figure 14). For both time periods, Canadian researchers are collaborating more intensively with foreign partners than their colleagues of other countries of a smaller size. The most central Canadian institutions in the network of inter-institutional collaboration (Figure 15) are, in decreasing order, the University of Toronto, the Center for Addiction and Mental Health, the University of British Columbia, McGill University and the Université de Montréal.

Table 8 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Addiction, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	% Internat			ARIF	Papers	% Internat			ARIF
		SI	Collabo	ARC			SI	Collabo	ARC	
United States	14 867	1,68	9,1%	1,33	1,22	19 690	1,85	13,8%	1,27	1,18
United Kingdom	2 001	0,84	20,3%	1,12	1,02	2 629	0,93	32,3%	1,23	1,10
Australia	1 092	1,51	17,4%	1,09	1,01	1 731	1,72	29,8%	1,10	1,07
Germany	1 167	0,52	23,1%	1,00	0,87	1 627	0,60	32,3%	1,13	0,95
Canada	1 152	1,00	29,1%	1,08	1,08	1 585	1,02	37,2%	1,23	1,11
Spain	1 370	1,82	12,7%	0,52	0,53	1 555	1,36	19,9%	0,69	0,65
France	882	0,54	23,7%	1,00	0,89	992	0,51	28,4%	1,03	0,92
Italy	724	0,68	26,0%	1,12	1,00	834	0,56	38,5%	1,30	1,07
Netherlands	440	0,68	27,5%	1,11	1,15	780	0,92	33,8%	1,27	1,15
Japan	727	0,30	19,4%	0,81	1,04	734	0,27	21,8%	0,71	0,94
Sweden	594	1,17	37,2%	0,96	1,12	671	1,11	44,6%	1,20	1,08
Switzerland	427	0,93	43,8%	1,20	1,09	629	1,02	55,6%	1,22	1,12
China	148	0,16	45,9%	1,02	0,88	500	0,18	48,8%	0,92	1,04
Brazil	199	0,57	30,2%	0,53	0,72	441	0,65	33,3%	0,51	0,84
Finland	436	1,78	43,1%	1,20	1,27	430	1,41	44,0%	1,01	1,05
Taiwan	126	0,38	24,6%	0,76	0,92	291	0,48	26,1%	0,57	0,90
Denmark	158	0,61	32,9%	1,01	1,20	281	0,86	42,0%	1,36	1,26
Belgium	174	0,51	43,7%	0,92	0,98	256	0,54	51,2%	1,30	1,10
Norway	162	0,98	42,0%	0,91	1,06	245	1,02	36,3%	1,05	1,05
Russia	196	0,22	30,6%	0,41	0,44	208	0,24	57,7%	0,67	0,72
World	26 136	1,00	-	1,11	1,07	33 983	1,00	-	1,09	1,06

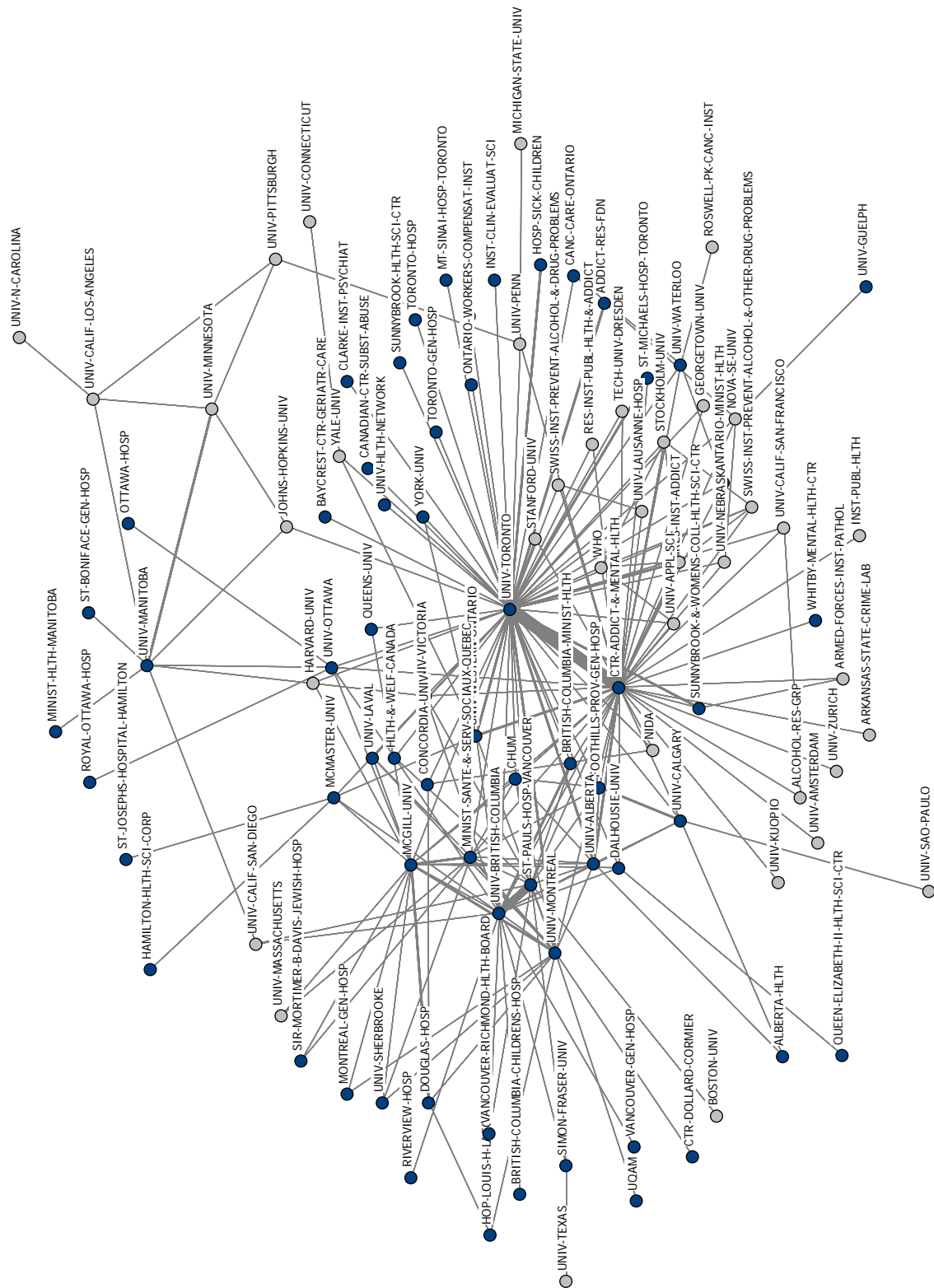
Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 14 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Addiction, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 15 Network of collaboration of Canadian institutions in the domain of Addiction, 1997-2008 (5 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

6 SENSES AND COMMUNICATION DISORDERS

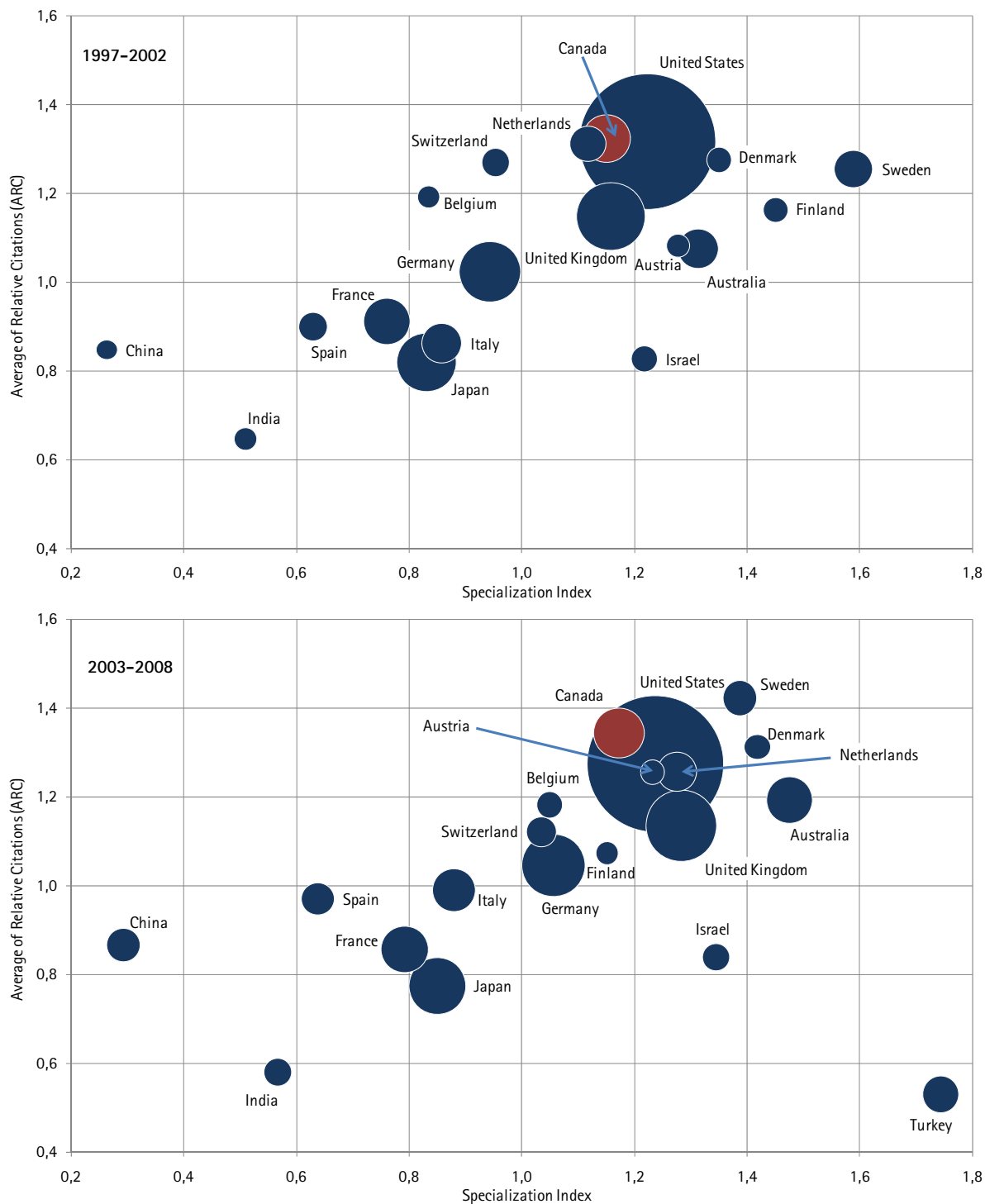
With an increase of 36% between 1997-2002 and 2003-2008, Canada's research output in Senses and Communication Disorders research maintained its fifth position among most productive countries (Table 9). Along the same lines, Canada remained specialized in this domain as its index increased slightly (from 1.15 to 1.17). For both time periods, Canada's scientific impact is well above world average and the country's ARC ranks second among countries presented in Table 9. In 2003-2008, other countries with high specialization and scientific impact in Senses and Communication Disorders research are the United States, United Kingdom, Australia, Netherlands, Sweden, Switzerland, Belgium, Denmark, Austria and Finland (see also Figure 16). International collaboration rates of Canadian papers are only slightly above that of countries of the same size. Given the high number of papers, the network of inter-institutional collaboration is relatively dense (Figure 17) and a high threshold had to be used (15 papers or more). The network shows that the most central Canadian institutions in the domain are University of Toronto, University of British Columbia, McGill University, University of Alberta and Université de Montréal.

Table 9 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of the Senses and Communication Disorders, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	% Internat		ARC	ARIF	Papers	% Internat		ARC	ARIF
United States	33 977	1,22	15,5%	1,32	1,18	40 842	1,24	20,8%	1,27	1,14
United Kingdom	8 615	1,16	22,8%	1,15	1,05	11 211	1,28	33,3%	1,14	1,06
Germany	6 700	0,94	24,8%	1,02	0,94	8 797	1,06	33,8%	1,05	0,92
Japan	6 258	0,83	13,8%	0,82	0,99	7 094	0,85	16,9%	0,77	0,97
Canada	4 150	1,15	30,6%	1,32	1,08	5 656	1,17	38,2%	1,34	1,07
France	3 927	0,76	20,9%	0,91	0,83	4 743	0,79	28,1%	0,86	0,85
Australia	2 974	1,31	22,8%	1,07	0,98	4 598	1,48	35,6%	1,19	1,04
Italy	2 865	0,86	22,5%	0,86	0,94	4 031	0,88	29,9%	0,99	0,99
Netherlands	2 266	1,12	29,4%	1,31	1,10	3 362	1,27	35,9%	1,26	1,13
Turkey	1 206	2,00	6,1%	0,46	0,65	2 836	1,74	6,3%	0,53	0,66
Sweden	2 544	1,59	25,8%	1,25	0,99	2 602	1,39	38,9%	1,42	1,03
China	760	0,26	39,1%	0,85	0,97	2 455	0,29	38,2%	0,87	0,98
Spain	1 490	0,63	20,8%	0,90	0,90	2 265	0,64	31,3%	0,97	0,93
Switzerland	1 376	0,95	40,0%	1,27	1,07	1 965	1,03	54,0%	1,12	1,08
India	928	0,51	18,9%	0,65	0,83	1 689	0,57	18,5%	0,58	0,84
Israel	1 239	1,22	23,8%	0,83	1,04	1 624	1,34	27,8%	0,84	1,02
Belgium	892	0,83	41,0%	1,19	1,03	1 540	1,05	46,2%	1,18	1,06
Denmark	1 102	1,35	26,8%	1,28	0,96	1 441	1,42	41,6%	1,31	1,10
Austria	972	1,28	29,7%	1,08	1,04	1 235	1,23	41,6%	1,26	1,04
Finland	1 115	1,45	25,0%	1,16	1,01	1 083	1,15	32,5%	1,07	1,08
World	82 155	1,00	-	1,04	1,02	105 218	1,00	-	1,00	1,00

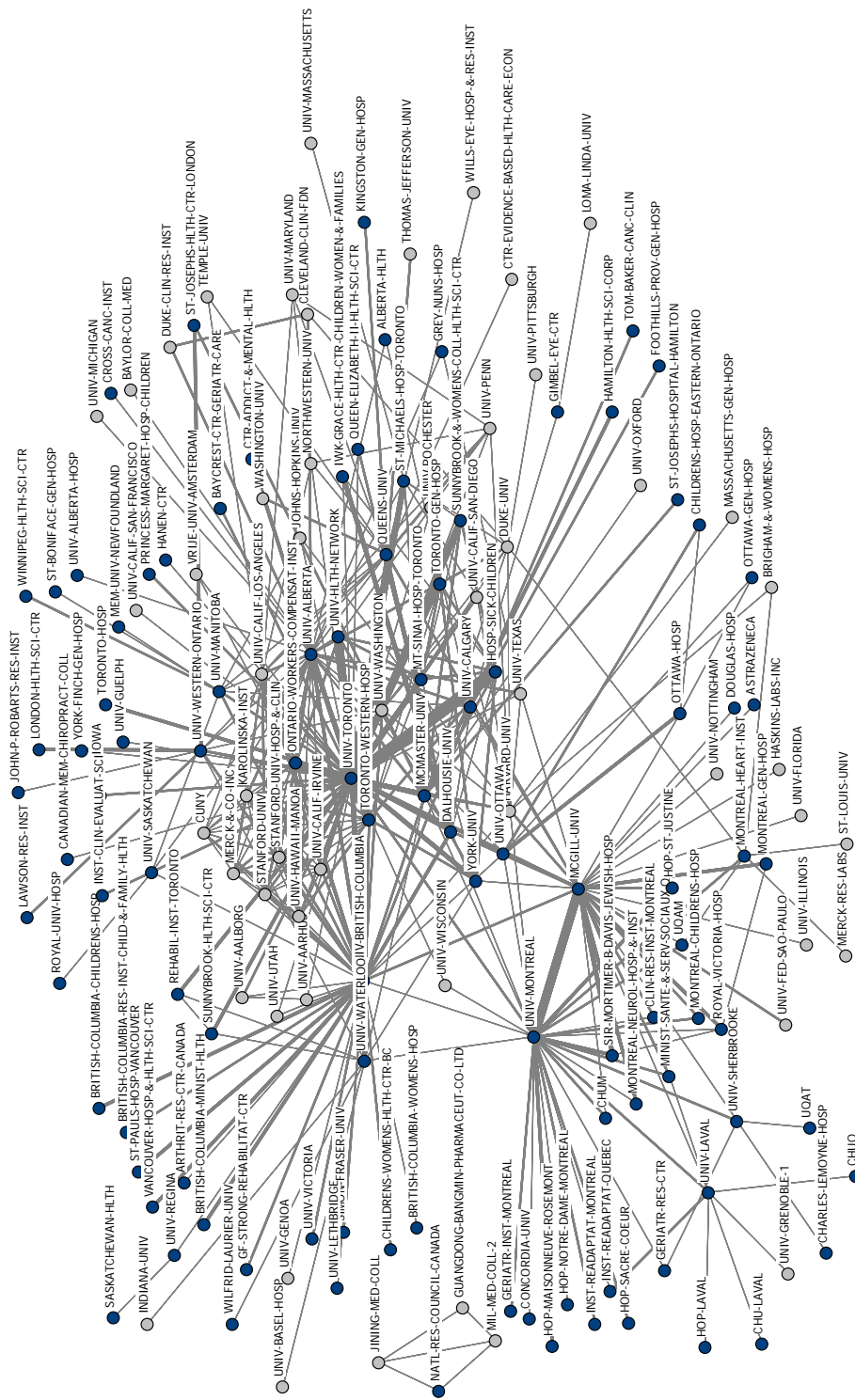
Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

Figure 16 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Senses and Communication Disorders, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 17 Network of collaboration of Canadian institutions in the domain of the Senses and Communication Disorders, 1997-2008 (8 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

6.1 Pain

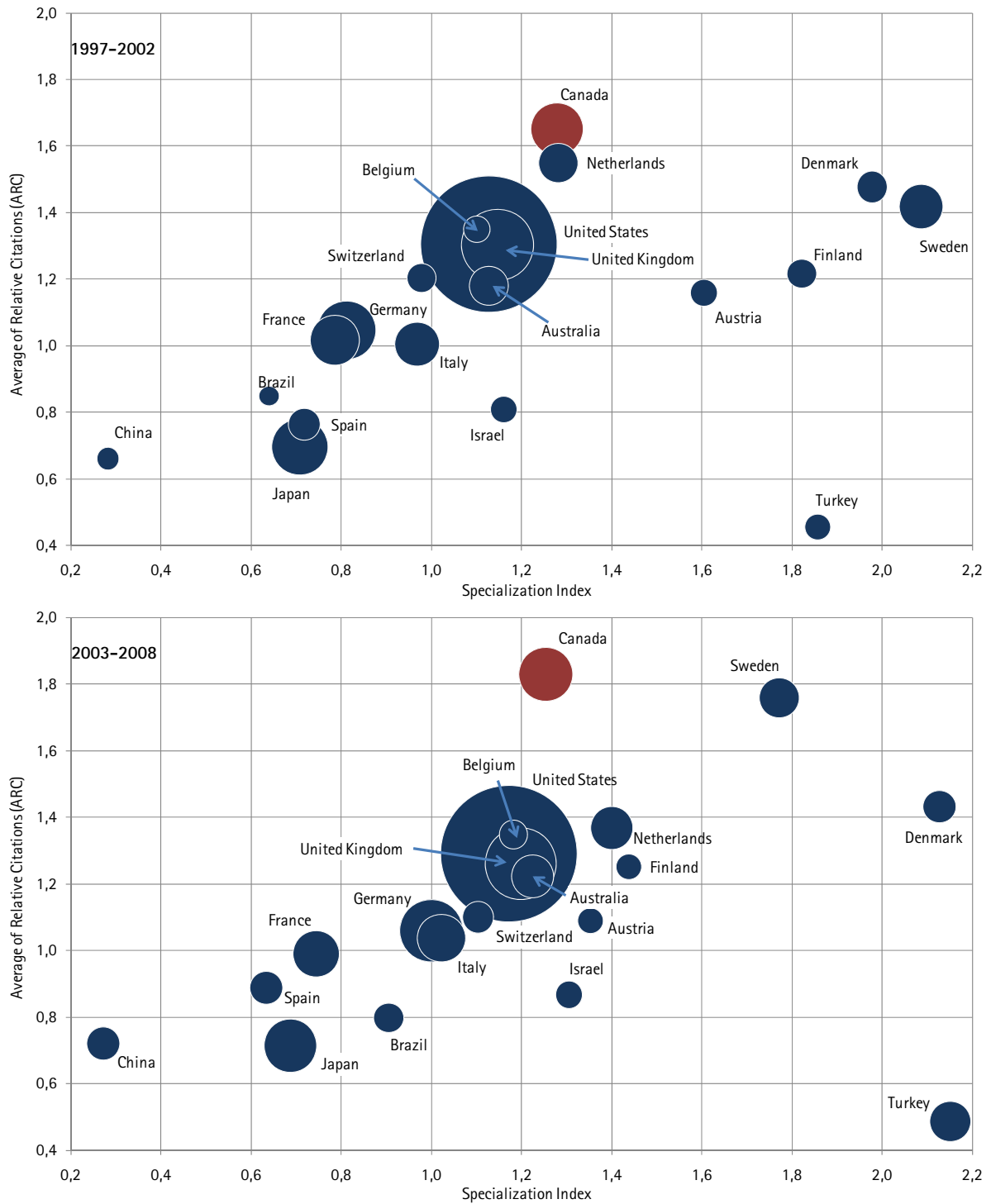
Between 1997-2002 and 2003-2008, Canada increased its rank among the most productive countries in Pain research from the fifth to the fourth rank, as its output surpassed that of Japan (Table 10). Canada also remained specialized in the domain, despite a very slight decrease of its index from 1.28 to 1.25 between 1997-2002 and 2003-2008. Significantly, the scientific impact of Canadian researchers leads the world both in terms of citations received (ARC) and journal impact (ARIF), and is the highest among top 20 countries for both time periods (i.e. ranked first). In 2003-2008, specialized countries having relatively high scientific impact in the domain are the United States, the United Kingdom, Australia, the Netherlands, Sweden, Denmark, Switzerland, Belgium and Finland (Figure 18). For both time periods, the international collaboration rate of Canadian researchers is above that of countries of the same size. The network of inter-institutional collaboration (Figure 19) shows that the most central Canadian institutions are University of Toronto, University of British Columbia, McGill University, University of Alberta and McMaster University.

Table 10 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Pain, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	% Internat		ARC	ARIF	Papers	% Internat		ARC	ARIF
United States	13 330	1,13	13,8%	1,31	1,13	17 049	1,17	18,6%	1,29	1,09
United Kingdom	3 637	1,15	19,7%	1,30	1,04	4 614	1,20	30,4%	1,26	1,08
Germany	2 450	0,81	23,0%	1,05	0,86	3 674	1,00	31,1%	1,06	0,91
Canada	1 964	1,28	27,8%	1,65	1,17	2 666	1,25	37,8%	1,83	1,15
Japan	2 268	0,71	9,7%	0,70	0,94	2 527	0,69	15,0%	0,72	0,91
Italy	1 378	0,97	22,3%	1,01	0,96	2 068	1,02	26,9%	1,04	0,98
France	1 726	0,78	15,8%	1,02	0,80	1 964	0,74	25,4%	0,99	0,88
Australia	1 087	1,13	22,4%	1,18	0,95	1 682	1,22	34,9%	1,22	1,02
Netherlands	1 106	1,28	27,1%	1,55	1,10	1 628	1,40	36,2%	1,37	1,18
Turkey	476	1,86	5,7%	0,45	0,65	1 543	2,15	4,3%	0,48	0,64
Sweden	1 421	2,09	23,2%	1,42	1,01	1 465	1,77	36,7%	1,76	1,05
China	346	0,28	28,0%	0,66	0,81	1 003	0,27	28,9%	0,72	0,89
Spain	724	0,72	17,0%	0,77	0,78	990	0,63	29,1%	0,89	0,84
Denmark	687	1,98	28,8%	1,48	1,03	953	2,13	42,9%	1,43	1,09
Switzerland	601	0,98	35,8%	1,20	1,01	924	1,10	52,1%	1,10	1,05
Brazil	297	0,64	21,5%	0,85	0,72	835	0,90	24,3%	0,80	0,84
Belgium	501	1,10	38,9%	1,35	1,01	765	1,18	50,1%	1,35	1,06
Israel	503	1,16	20,5%	0,81	0,96	695	1,30	25,8%	0,87	0,95
Austria	520	1,60	36,2%	1,16	1,06	598	1,35	44,6%	1,09	0,99
Finland	596	1,82	21,0%	1,22	1,04	597	1,44	32,0%	1,25	1,13
World	34 974	1,00	-	1,06	0,97	46 410	1,00	-	1,00	0,96

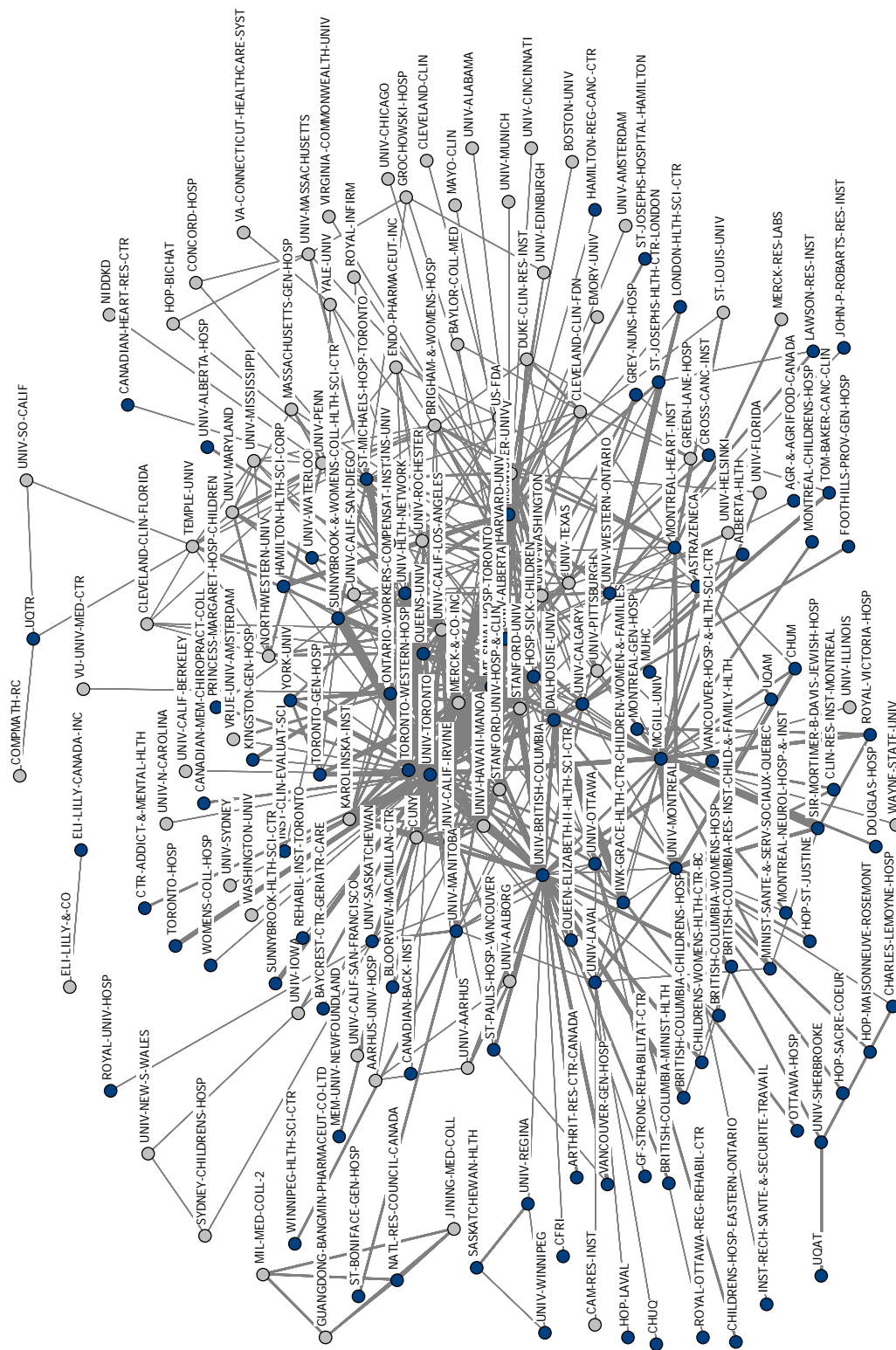
Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 18 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Pain, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 19 Network of collaboration of Canadian institutions in the domain of Pain, 1997-2008 (5 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

7 CROSS-CIHR STRATEGIC INITIATIVES

7.1 Regenerative Medicine

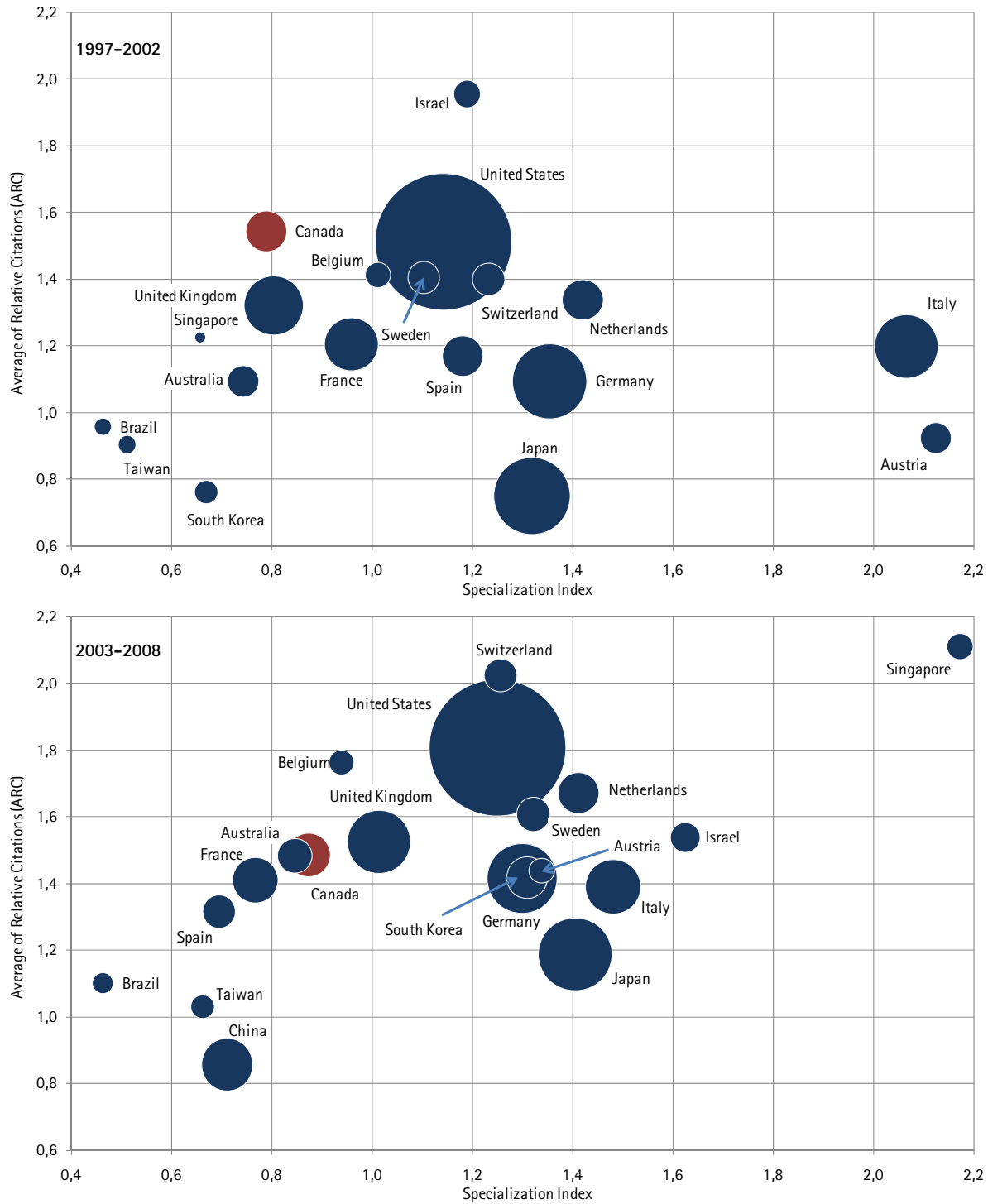
Despite the fact that Canada's research output in Regenerative Medicine increased almost threefold between 1997-2002 and 2003-2008, its rank remained stable (8th) as other countries' output grew at a comparable pace (Table 11). Canada's specialization index in the domain increased from 0.79 to 0.87, but its relative effort still remained below world average. Its scientific impact, on the other hand, is well above world average, both in terms of citations received (ARC) and journal impact (ARIF). In 2003-2008, countries with high impact and specialization in the domain are the United States, the United Kingdom, the Netherlands, Sweden, Switzerland, Israel, and Singapore (Figure 20). The international collaboration rate of Canada is one of the highest among countries mentioned in Table 11. Given the lower number of papers, the network of inter-institutional collaboration is less dense (Figure 21) than many of the other domains examined here. The most central Canadian institutions in the network are the Princess Margaret Hospital, University of Toronto, the Toronto General Hospital, University of British Columbia and University of Calgary (Figure 21).

Table 11 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Regenerative Medicine, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	SI	% Internat Collabo	ARC	ARIF	Papers	SI	% Internat Collabo	ARC	ARIF
United States	3 903	1,14	16,7%	1,51	1,12	10 636	1,25	24,5%	1,81	1,27
Japan	1 221	1,32	14,2%	0,75	0,75	3 029	1,41	17,0%	1,19	0,99
Germany	1 182	1,35	27,9%	1,09	0,85	2 792	1,30	37,5%	1,42	1,06
United Kingdom	735	0,80	29,1%	1,32	0,99	2 282	1,01	37,0%	1,53	1,21
Italy	849	2,06	25,9%	1,20	0,91	1 751	1,48	37,1%	1,39	1,04
China	106	0,30	25,5%	0,76	0,70	1 540	0,71	23,0%	0,86	0,87
France	609	0,96	26,4%	1,20	0,96	1 184	0,77	41,1%	1,41	1,14
Canada	350	0,79	38,9%	1,54	1,13	1 086	0,87	41,9%	1,49	1,20
South Korea	114	0,67	16,7%	0,76	0,70	992	1,31	23,9%	1,42	0,95
Netherlands	354	1,42	33,6%	1,34	1,06	959	1,41	43,7%	1,67	1,24
Australia	207	0,74	28,0%	1,09	0,89	679	0,84	42,4%	1,48	1,10
Sweden	217	1,10	41,9%	1,40	0,96	639	1,32	48,7%	1,61	1,15
Spain	344	1,18	22,4%	1,17	0,83	635	0,69	38,3%	1,32	1,06
Switzerland	219	1,23	50,2%	1,40	0,99	615	1,25	63,9%	2,02	1,29
Israel	149	1,19	40,9%	1,96	1,06	506	1,62	39,3%	1,54	1,11
Singapore	29	0,66	37,9%	1,22	0,71	389	2,17	40,1%	2,11	1,20
Belgium	133	1,01	42,1%	1,41	0,99	355	0,94	50,1%	1,76	1,17
Austria	199	2,12	35,2%	0,92	0,81	346	1,34	50,6%	1,44	1,00
Taiwan	65	0,51	10,8%	0,90	0,86	317	0,66	18,9%	1,03	1,06
Brazil	62	0,46	27,4%	0,96	0,79	250	0,46	34,0%	1,10	0,91
World	10 105	1,00	-	1,11	0,90	27 135	1,00	-	1,38	1,09

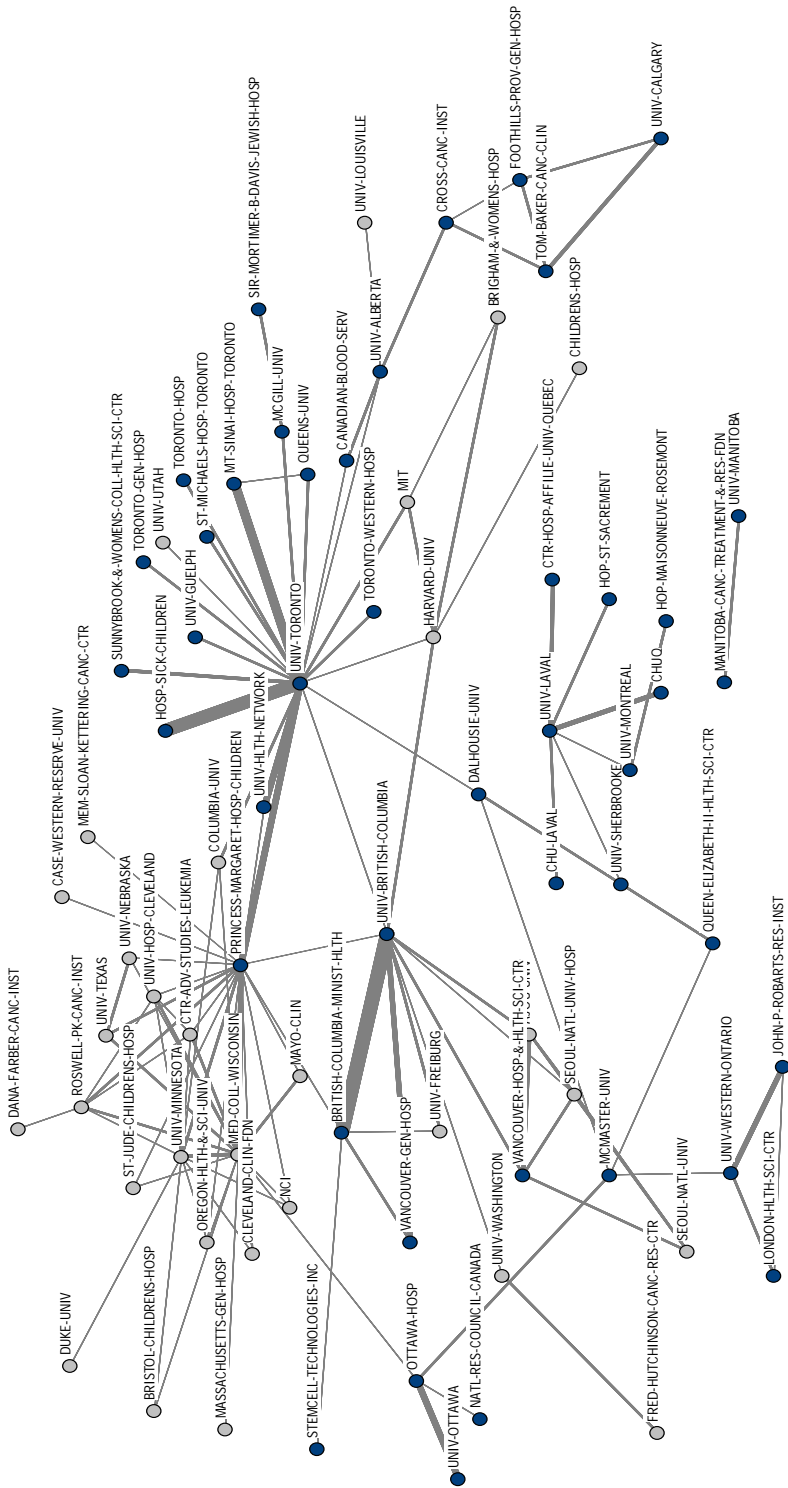
Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

Figure 20 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Regenerative Medicine, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 21 Network of collaboration of Canadian institutions in the domain of Regenerative Medicine 1997-2008 (5 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

7.2 Nanomedicine

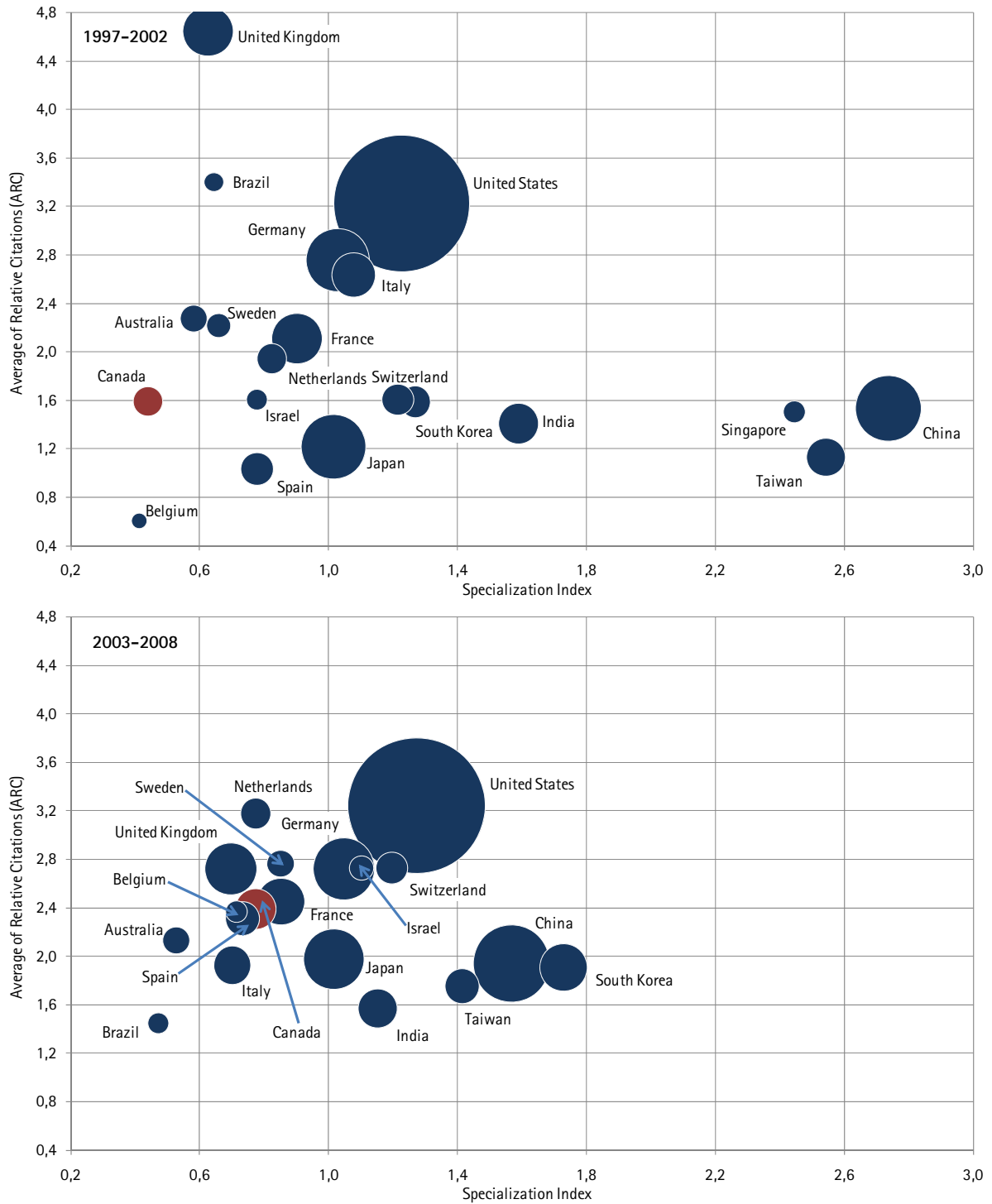
The domain of Nanomedicine has increased tremendously at the world level since the beginning of the period studied, from 936 papers published between 1997 and 2002 to 25,974 between 2003 and 2008 (Table 12). Although Canada's rank significantly increased from 14th to 8th between two time periods in terms of number of publications, it is still below most of the other domains examined here. Along the same lines, the country remained under specialized in this domain, even though its specialization index increased considerably from 0.44 in 1997-2002 to 0.77 in 2003-2008. Moreover, the scientific impact of Canadian papers in the domain increased even further, and now nears the world average of the domain. Worth mentioning is the high scientific impact and specialization of the United States, Germany, Switzerland and Israel, and the relatively low impact despite high specialization of China, South Korea and Taiwan (see also Figure 22). The table also shows that Canadian researchers' international collaboration activities are below those of bigger countries. Figure 23 shows that the most central Canadian institutions are, in decreasing order of importance, University of British Columbia, University of Toronto, University of Alberta, the National Research Council of Canada and McGill University.

Table 12 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Nanomedicine, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	% Internat				Papers	% Internat			
		SI	Collabo	ARC	ARIF		SI	Collabo	ARC	ARIF
United States	388	1,22	19,1%	3,23	1,63	10 375	1,27	20,5%	3,24	2,14
China	90	2,74	15,6%	1,53	0,83	3 252	1,57	22,0%	1,94	1,45
Germany	83	1,03	43,4%	2,76	1,43	2 151	1,05	50,0%	2,72	2,07
Japan	87	1,01	23,0%	1,22	1,18	2 093	1,01	25,6%	1,97	1,65
United Kingdom	53	0,62	35,8%	4,64	1,45	1 501	0,70	45,0%	2,72	1,99
France	53	0,90	47,2%	2,11	1,21	1 257	0,85	49,5%	2,45	1,89
South Korea	20	1,27	40,0%	1,59	1,45	1 254	1,73	27,0%	1,91	1,67
Canada	18	0,44	33,3%	1,59	1,39	919	0,77	39,0%	2,39	1,83
India	33	1,59	15,2%	1,41	1,62	848	1,15	19,3%	1,57	1,34
Italy	41	1,08	39,0%	2,63	1,37	792	0,70	48,4%	1,93	1,74
Taiwan	30	2,54	13,3%	1,13	1,09	648	1,41	15,6%	1,75	1,50
Spain	21	0,78	57,1%	1,04	1,94	640	0,73	48,4%	2,31	1,77
Switzerland	20	1,21	50,0%	1,60	1,02	560	1,19	49,8%	2,73	2,04
Singapore	10	2,44	40,0%	1,50	1,08	548	3,20	31,8%	2,44	1,64
Netherlands	19	0,82	42,1%	1,94	2,32	503	0,77	50,9%	3,18	2,23
Australia	15	0,58	46,7%	2,27	1,37	404	0,53	48,8%	2,13	1,71
Sweden	12	0,66	33,3%	2,22	1,58	394	0,85	48,0%	2,77	2,20
Israel	9	0,78	11,1%	1,60	1,83	328	1,10	33,8%	2,73	2,21
Belgium	5	0,41	80,0%	0,60	1,80	258	0,71	55,4%	2,37	1,96
Brazil	8	0,64	37,5%	3,40	1,45	243	0,47	37,0%	1,44	1,44
World	936	1,00	-	2,43	1,42	25 974	1,00	-	2,51	1,83

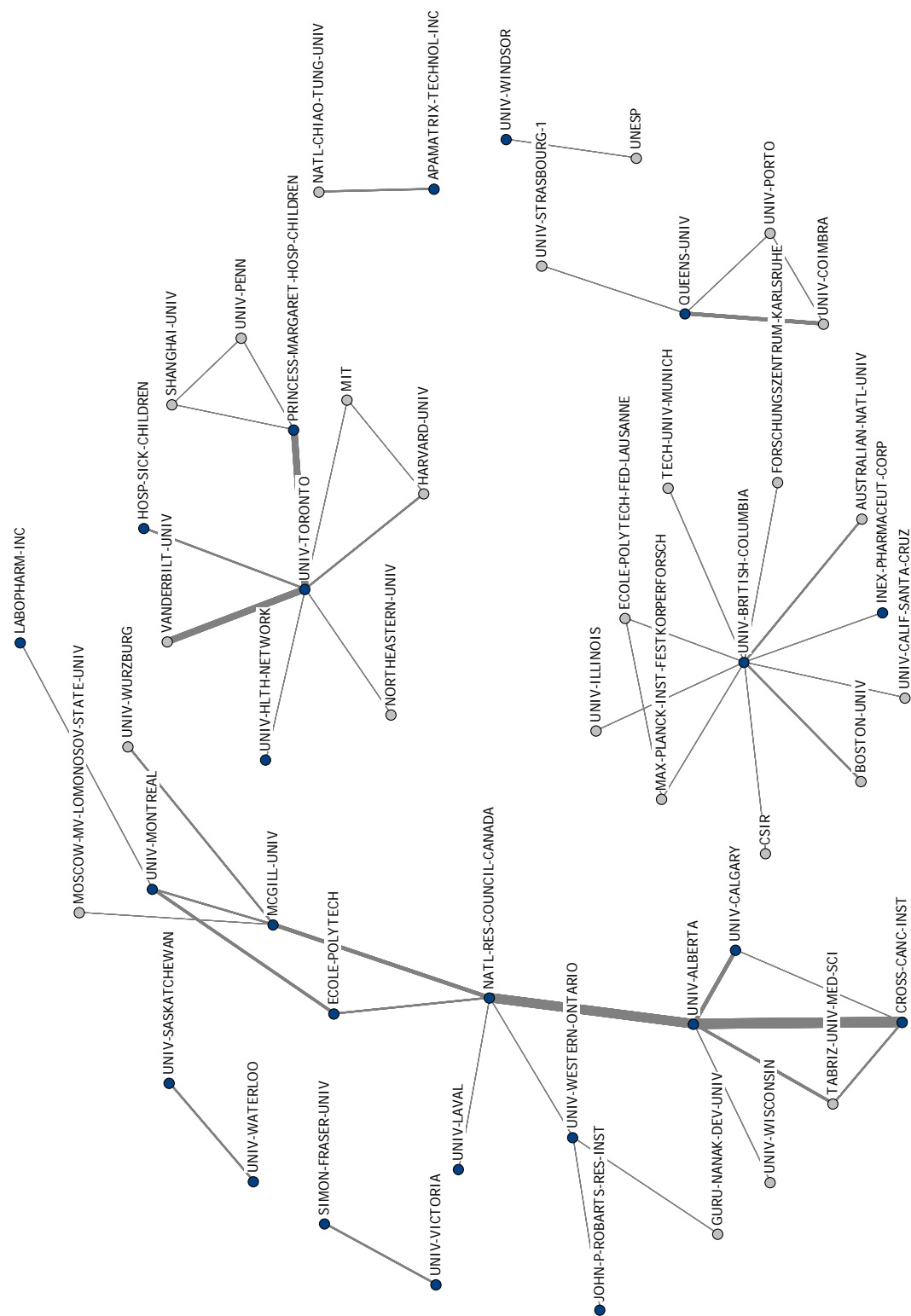
Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 22 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Nanomedicine, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 23 Network of collaboration of Canadian institutions in the domain of Nanomedicine, 1997-2008 (3 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

7.3 Epigenetics

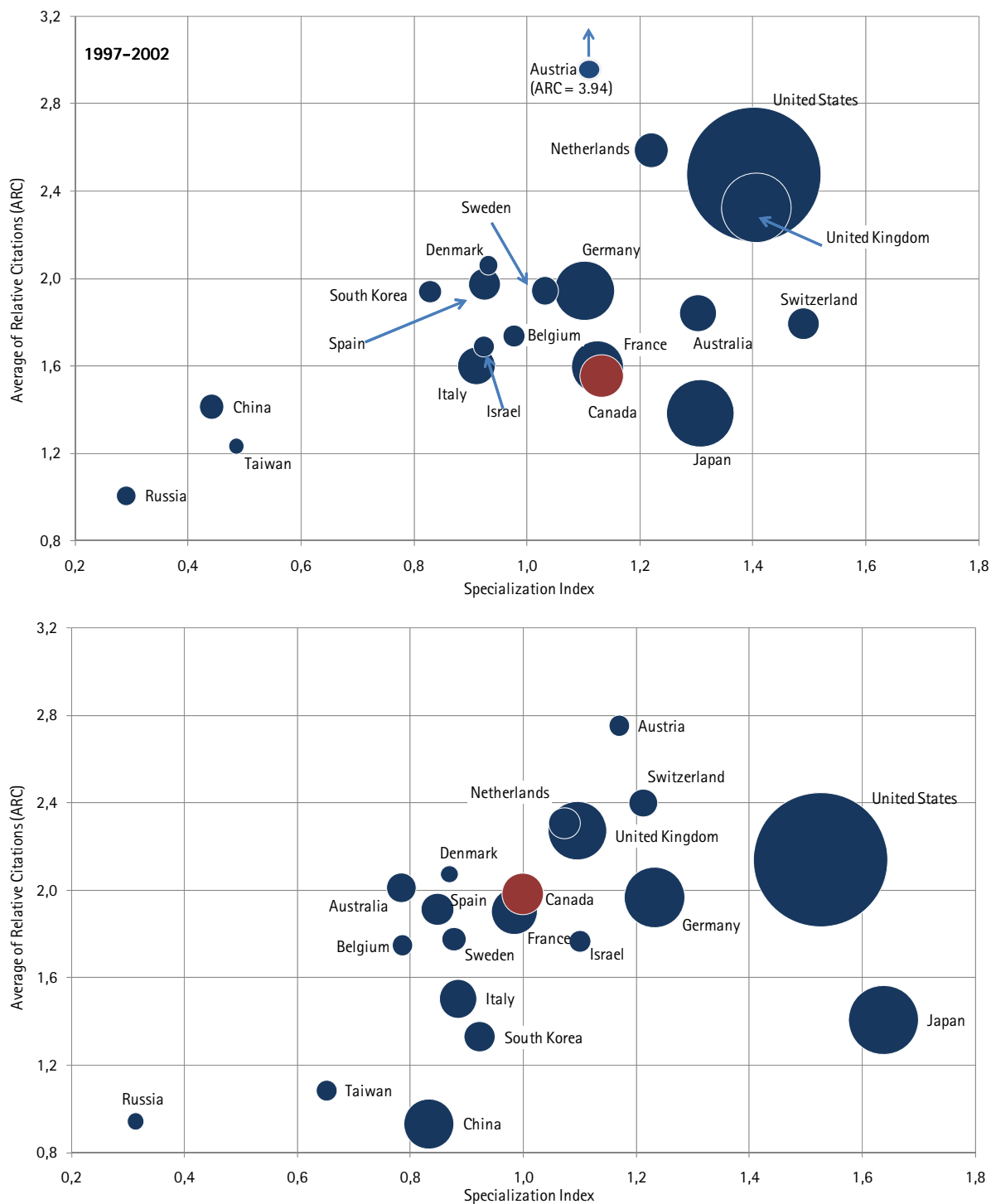
Even though Canada's research output in Epigenetics increased more than threefold between 1997-2002 and 2003-2008, its worldwide rank decreased from sixth to seventh as; 1) the number of papers published in the domain increased at the world level by a factor of almost four, and 2) China increased its output in the domain from 99 papers in 1997-2002 to 1,523 in 2002-2008 (Table 13). Along the same lines, Canada is no longer considered specialized in this domain as its specialization index decreased from 1.13 to 1.00. Scientific impact, on the other hand, followed a different path and increased from being below world average to being well above, in terms of citations received (ARC), and on a par in terms of journal impact (ARIF). In 2003-2008, countries with above average specialization and scientific impact in Epigenetics are the United States, Germany, the United Kingdom, the Netherlands, Switzerland and Austria (Figure 24). The international collaboration rate of Canadian researchers is similar to that of countries of the same size, and higher than most of the domains examined here. Given the lower number of papers, the network of inter-institutional collaboration is less dense (Figure 25) than many of the other domains examined here. The most central Canadian institutions in the network are, in decreasing order, McGill University, University of Toronto, and The Hospital for Sick Children, University of British Columbia and University of Western Ontario.

Table 13 Number of papers, specialization index, international collaboration and scientific impact of the 20 most active countries in the domain of Epigenetics, 1997-2002 and 2003-2008

Country	1997-2002					2003-2008				
	Papers	SI	Collabo	ARC	ARIF	Papers	SI	Collabo	ARC	ARIF
United States	3 023	1,40	27,9%	2,48	1,83	10 958	1,52	30,5%	2,14	1,66
Japan	764	1,31	31,0%	1,38	1,31	2 976	1,64	28,8%	1,41	1,27
Germany	607	1,10	50,9%	1,94	1,49	2 232	1,23	46,5%	1,97	1,56
United Kingdom	812	1,41	45,7%	2,32	1,78	2 083	1,10	50,5%	2,27	1,70
China	99	0,44	32,3%	1,41	1,02	1 523	0,83	36,0%	0,93	1,05
France	451	1,12	43,9%	1,60	1,57	1 281	0,98	55,0%	1,91	1,61
Canada	317	1,13	42,0%	1,55	1,38	1 048	1,00	52,8%	1,98	1,45
Italy	236	0,91	55,1%	1,60	1,40	881	0,88	48,4%	1,50	1,40
Spain	170	0,92	39,4%	1,98	1,45	654	0,85	45,9%	1,91	1,47
Netherlands	192	1,22	55,2%	2,59	1,80	615	1,07	60,0%	2,31	1,84
South Korea	89	0,83	39,3%	1,94	1,40	590	0,92	31,7%	1,33	1,25
Australia	229	1,30	39,3%	1,84	1,38	531	0,78	51,2%	2,01	1,56
Switzerland	167	1,49	49,7%	1,79	1,62	501	1,21	58,5%	2,40	1,77
Sweden	128	1,03	65,6%	1,94	1,46	358	0,88	71,2%	1,77	1,52
Israel	73	0,92	56,2%	1,69	1,66	289	1,10	46,7%	1,77	1,65
Taiwan	39	0,49	35,9%	1,23	1,38	263	0,65	31,6%	1,08	1,22
Austria	65	1,10	53,8%	3,94	2,19	255	1,17	62,0%	2,75	1,86
Belgium	81	0,98	56,8%	1,74	1,36	251	0,79	61,4%	1,75	1,58
Denmark	59	0,93	62,7%	2,06	1,44	192	0,87	63,0%	2,07	1,53
Russia	64	0,29	65,6%	1,01	1,03	185	0,31	53,0%	0,94	0,89
World	6 375	1,00	-	1,96	1,58	22 895	1,00	-	1,79	1,47

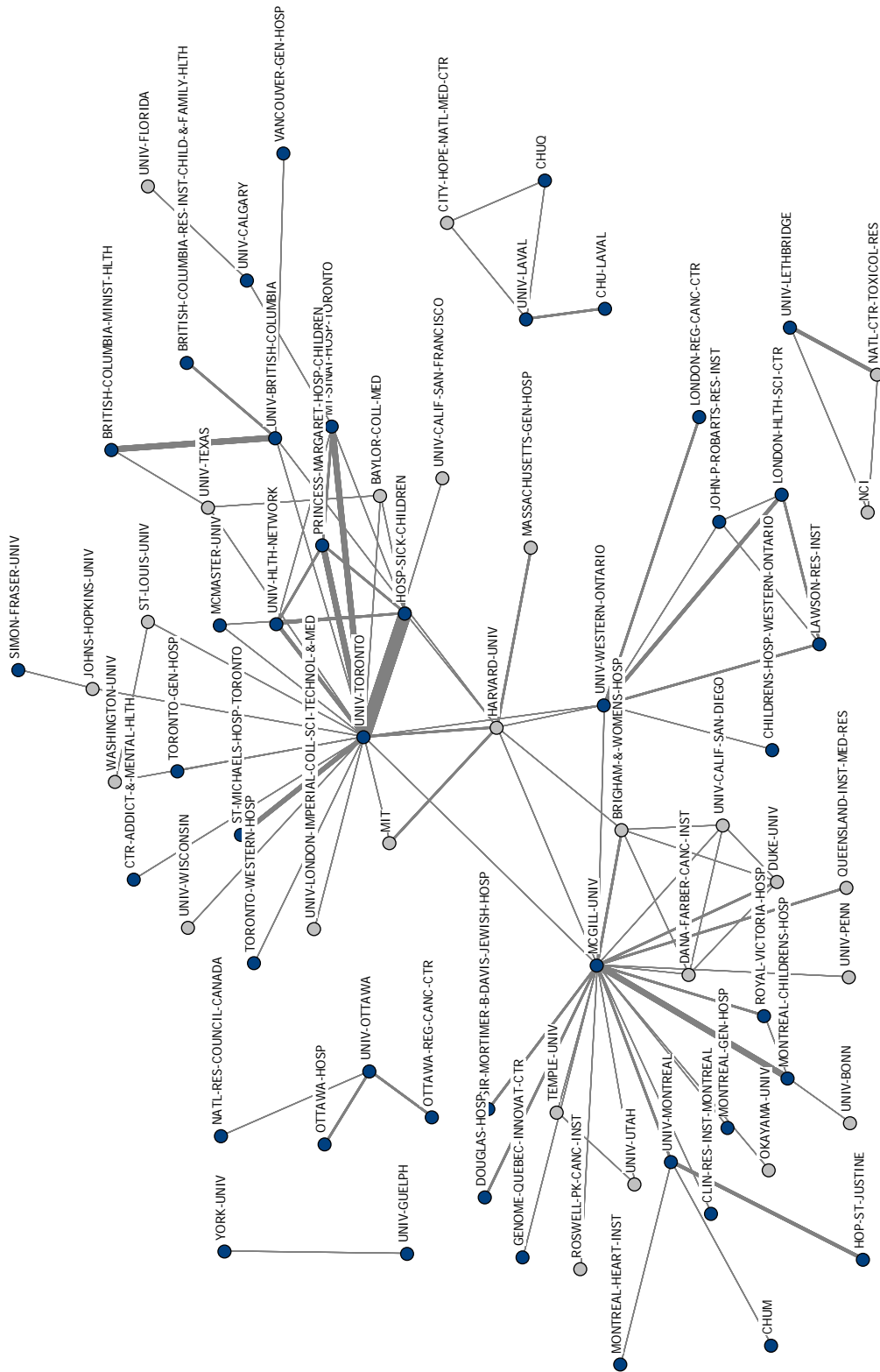
Source: *Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.*

Figure 24 Scatterplots of the average of relative citations and specialization index of top 20 most productive countries in the domain of Epigenetics, 1997-2002 and 2003-2008



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

Figure 25 Network of collaboration of Canadian institutions in the domain of Epigenetics, 1997-2008 (4 joint publications or more)



Source: Observatoire des sciences et des technologies, CBD (current as of July 2009), Web of Science and Medline databases.

CONCLUSION

Using a method based on the U.S. National Library of Medicine Medical Subject Headings (MeSH) and on the selection of "core" journals, the present bibliometric report analyzes the evolution, over the 1997-2008 period, of research trends relevant to CIHR INMHA. Specifically, research domains examined include the 4 main mandate areas of INMHA (Neurosciences, Mental Health, Addiction, and the Senses and Communication Disorders), as well as 3 focused research areas (Neuroimaging, Neural Stem Cells, and Pain), and 3 broader CIHR-wide domains where INMHA has a leadership role (Regenerative Medicine, Nanomedicine, and Epigenetics). The research output, specialization, scientific impact and collaboration of Canadian researchers are presented and compared, in each of these domains, with that of researchers of the 20 countries that are the most productive.

Main INMHA Mandate Domains - Neurosciences, Mental Health, Addiction, and the Senses and Communication Disorders

This report provides evidence that Canada has a leadership position in all of the main domains relevant to INMHA.

In terms of research output (number of papers), all four domains show a relatively high and stable position among the world countries, with Canada ranking 4-6th across all domains and time periods. Although Canada's bibliometric output in other scientific domains was not directly measured in this study, this rank seems high relative to published R&D statistics from the Organization for Economic Cooperation and Development (OECD).⁹ Comparing Canada's performance to the OECD statistical profiles of the top 20 countries identified for each of the domains in this report, Canada's relative rank is 11th in terms of R&D expenditure as a percentage of Gross Domestic Product (GDP), 9th in terms of number of researchers per employed population, and 11th in terms of triadic patent families.¹⁰ Thus, the 4-6th place research output rank for the main INMHA domains observed here suggests these are areas of relative research intensity for Canada.

In terms of relative scientific impact, Canadian publications in three of these domains - Neurosciences, Mental Health and the Senses and Communication Disorders - were consistently well above the world average in terms of citations received (ARC) and journal impact (ARIF) over the entire 1997-2008 time period (e.g. 2nd to 4th rank for ARC). In the domain of Addictions research, scientific impact of Canadian publications was in line with the world average in 1997-2002, but increased in the 2003-2008 time period. These results suggest an increasing or stably high level of research excellence in Canada for the main INMHA domains.

Analysis of collaboration data reveals that Canadian researchers are well networked in the main INMHA domains studied in this report, with increasing levels of international collaborators for all four domains in 2003-2008.

Sub-domains of INMHA Mandate - Neuroimaging, Neural Stem Cells, and Pain

Overall research output (number of papers) for these sub-domains was consistent with the relatively high rank of the main INMHA domains noted above. However, scientific impact (ARC and ARIF) was generally even higher than that observed for the broader main domains. Both Pain and Neuroimaging consistently maintained very high impact rankings over time, with ARC ranks of 1st and 3rd overall in the world, respectively, over both 1997-2002 and 2003-2008 time periods. For Neural Stem Cells, despite an early relative lead in citations in 1997-2002 (4th rank for ARC), citations have dropped in the more recent 2003-2008 period (8th rank for ARC). However, this later result needs to be interpreted with caution, given the

low relative number of publications in the Neural Stem Cell sub-domain compared to others examined here.

Canadian researchers are well networked in these sub-domains, with Neural Stem Cells showing a relatively high level of international collaboration (i.e. 50% of Canadian publications have international authors). As with the main INMHA domains, Neuroimaging and Pain both increased international collaborations over time, while Neural Stem Cells remained stable at its relatively high level.

Cross-CIHR Domains – Regenerative Medicine, Nanomedicine and Epigenetics

Consistent with the nascent and emerging nature of these multi-disciplinary and cross-themed research domains, overall research output is low compared to the well established INMHA domains. As a result, interpretation of bibliometric findings needs to be done with care. With the exception of the domain of Nanomedicine in 1997-2002 (where the low number of publications potentially invalidates relative comparisons), Canada's overall research output was consistently in the 6th to 8th rank for top 20 world countries for all three domains and both time periods. Nevertheless, Canada's Specialization Index (SI) typically remained below the world average for Regenerative Medicine and Nanomedicine and at the world average for Epigenetics.

For Regenerative Medicine, Canada's scientific impact (ARC and ARIF) was consistently above the world average for both 1997-2002 and 2003-2008 time periods, despite a below average specialization (SI). However, its relative rank among top world countries decreased over time, as a number of other countries significantly increased their scientific impact while Canada remained stable.

For Nanomedicine, comparisons over time are difficult, due to the low number of papers published in 1997-2002. However, Canada appears to have increased from a below-world average in research output, impact (ARC and ARIF) and SI in 1997-2002, to an average impact despite a below-average specialization in 2003-2008.

For Epigenetics, Canada's relative specialization has dropped slightly over time, to the world average in 2003-2008. Nevertheless, Canada has increased its relative scientific impact from a below-world average in 1997-2002, to an above-world average in 2003-2008. International collaboration rates are relatively high for Epigenetics (i.e. >50% of papers have international collaborators).

SUMMARY

This report provides bibliometric evidence that Canadian researchers excel on the world stage, for the four domains (Neurosciences, Mental Health, Addiction, and the Senses and Communication Disorders) and three sub-domains (Neuroimaging, Neural Stem Cells, and Pain) relevant to INMHA's mandate. Canada's relative research output and scientific impact in these domains exceeded what would be expected based on Canada's overall R&D research spending, relative to other countries (OECD Country Statistical Profiles, 2010). Research output and impact either remained stable over the 1997-2002 and 2003-2008 time periods, or increased in all INMHA-relevant domains.

For emerging cross-CIHR domains where INMHA plays a leadership role (Regenerative Medicine, Nanomedicine, Epigenetics), Canada's research output is typically lower than in the established INMHA domains, as expected. Canada is at or below the world average for specialization in all three domains, but still has above average scientific impact in Regenerative Medicine and Epigenetics. Nanomedicine research output, specialization and impact have increased considerably in recent years, and now approach the world average.

ENDNOTES

¹ CIHR Act – Bill C13 : <http://www2.parl.gc.ca/HousePublications/Publication.aspx?pub=bill&doc=C-13&parl=36&ses=2&file=28&language=E>

² Institute of Neurosciences, Mental Health and Addiction (INMHA):
<http://www.cihr-irsc.gc.ca/e/8602.html>

³ <http://www.nsf.gov/statistics/seind06/>

⁴ <http://www.ncbi.nlm.nih.gov/pubmed>

⁵ More details on the classification scheme can be found at:
<http://www.nsf.gov/statistics/seind06/c5/c5s3.htm#sb1>

⁶ Freeman, L. C. (1979). Centrality in social networks: Conceptual clarification. *Social Networks*, 1(3): 215-239.

⁷ Borgatti, S.P., Everett, M.G. et L.C Freeman (2002) *Ucinet for Windows: Software for Social Network Analysis*. Harvard: Analytic Technologies.

⁸ Borgatti, S. P. (2002) *NetDraw: Graph Visualization Software*. Harvard: Analytic Technologies.

⁹ OECD Factbook 2010: Economic, Environmental and Social Statistics – ISBN 92-64-08356-1 – © OECD 2010.

¹⁰ OECD Country Statistical Profiles 2010: <http://stats.oecd.org/Index.aspx?DataSetCode=CSP2010>

APPENDIX 1. MESH TERMS, BY DOMAIN

Neuroscience

Mental Disorders
Nervous System
Nervous System Diseases
Neurology
Neuropharmacology
Neurosciences
Psychopharmacology

Neuroimaging

Brain Mapping
Diagnostic Imaging
Diagnostic Techniques, Neurological
Electroencephalography
Magnetoencephalography
Neuroradiography
Transcranial Magnetic Stimulation

Neural Stem Cells

Stem Cells (limited by "Neuroscience" MeSH—see above)

Mental Health

Mental Disorders
Mental Health
Mental Health Services

Addiction

Substance-Related Disorders
Tobacco Use Cessation

Senses and Communication Disorders

Gravity Sensing
Sensation (except the "pleasure" subheading)
Hearing
Pain
Proprioception
Smell
Taste
Temperature Sense
Touch
Vision, Ocular

Pain

Pain

Regenerative Medicine

Adult Stem Cells

Bioartificial Organs

Embryonic Stem Cells

Fetal Stem Cells

Liver, Artificial

Multipotent Stem Cells

Organoids

Pancreas, Artificial

Pluripotent Stem Cells

Regenerative Medicine

Skin, Artificial

Stem Cell Transplantation

Tissue Engineering

Tissue Scaffolds

Tissue Therapy

Totipotent Stem Cells

Nanomedicine

Fullerenes

Lab-On-A-Chip Devices

Microfluidic Analytical Techniques

Microfluidics

Nanocapsules

Nanomedicine

Nanostructures

Nanotechnology

Epigenetics

Epigenesis, Genetic

DNA Methylation

APPENDIX 2. JOURNALS INCLUDED, BY DOMAIN

Neuroscience

ACTA NEUROBIOLOGIAE EXPERIMENTALIS
ACTA NEUROLOGICA
ACTA NEUROLOGICA BELGICA
ACTA NEUROLOGICA SCANDINAVICA
ACTA NEUROPATHOLOGICA
ACTA NEUROPSYCHIATRICA
ACTAS LUSO-ESPAÑOLAS DE NEUROLOGIA PSIQUIATRIA Y CIENCIAS AFINES
ACTIVITAS NERVOSA SUPERIOR
ACUPUNCTURE & ELECTRO-THERAPEUTICS RESEARCH
ADVANCES IN BEHAVIORAL PHARMACOLOGY
ADVANCES IN BIOCHEMICAL PSYCHOPHARMACOLOGY
ADVANCES IN NEUROLOGY
AGING NEUROPSYCHOLOGY AND COGNITION
AKTUELLE NEUROLOGIE
ALZHEIMER DISEASE & ASSOCIATED DISORDERS
ALZHEIMERS & DEMENTIA
ALZHEIMERS REPORTS
AMA ARCHIVES OF NEUROLOGY AND PSYCHIATRY
AMERICAN JOURNAL OF EEG TECHNOLOGY
AMERICAN JOURNAL OF ELECTRONEURODIAGNOSTIC TECHNOLOGY
AMERICAN JOURNAL OF MEDICAL GENETICS PART B-NEUROPSYCHIATRIC GENETICS
AMERICAN JOURNAL OF NEURORADIOLOGY
AMYOTROPHIC LATERAL SCLEROSIS AND OTHER MOTOR NEURON DISORDERS
ANNALS OF INDIAN ACADEMY OF NEUROLOGY
ANNALS OF NEUROLOGY
ANNUAL REVIEW OF NEUROSCIENCE
APHASIOLOGY
APPLIED NEUROPHYSIOLOGY
APS JOURNAL
ARCHIVES ITALIENNES DE BIOLOGIE
ARCHIVES OF NEUROLOGY
ARCHIVES OF NEUROLOGY AND PSYCHIATRY
ARCHIVOS DE NEUROBIOLOGIA
ARQUIVOS DE NEURO-PSIQUIATRIA
AUTONOMIC NEUROSCIENCE-BASIC & CLINICAL
BAILLIERES CLINICAL NEUROLOGY
BEHAVIORAL AND BRAIN FUNCTIONS
BEHAVIORAL AND NEURAL BIOLOGY
BEHAVIORAL NEUROSCIENCE
BEHAVIOURAL BRAIN RESEARCH
BEHAVIOURAL NEUROLOGY
BEHAVIOURAL PHARMACOLOGY
BIOLOGICAL CYBERNETICS
BMC NEUROLOGY
BMC NEUROSCIENCE
BRAIN
BRAIN & DEVELOPMENT

BRAIN AND COGNITION
BRAIN AND LANGUAGE
BRAIN BEHAVIOR AND EVOLUTION
BRAIN CELL BIOLOGY
BRAIN DYSFUNCTION
BRAIN IMPAIRMENT
BRAIN INJURY
BRAIN PATHOLOGY
BRAIN RESEARCH
BRAIN RESEARCH BULLETIN
BRAIN RESEARCH PROTOCOLS
BRAIN RESEARCH REVIEWS
BRAIN STRUCTURE & FUNCTION
BRAIN TOPOGRAPHY
BRITISH JOURNAL OF NEUROSURGERY
CANADIAN JOURNAL OF NEUROLOGICAL SCIENCES
CELL TRANSPLANTATION
CELLULAR AND MOLECULAR NEUROBIOLOGY
CEPHALALGIA
CEREBELLUM
CEREBRAL CORTEX
CEREBROVASCULAR AND BRAIN METABOLISM REVIEWS
CEREBROVASCULAR DISEASES
CHILD NEUROPSYCHOLOGY
CHILDS BRAIN
CHILDS NERVOUS SYSTEM
CHRONOBIOLOGY INTERNATIONAL
CIRCULATION ET METABOLISME DU CERVEAU
CLINICAL AUTONOMIC RESEARCH
CLINICAL EEG AND NEUROSCIENCE
CLINICAL ELECTROENCEPHALOGRAPHY
CLINICAL JOURNAL OF PAIN
CLINICAL NEUROLOGY AND NEUROSURGERY
CLINICAL NEUROPATHOLOGY
CLINICAL NEUROPHYSIOLOGY
CLINICAL NEUROPSYCHOLOGY
CLINICAL NEUROSCIENCE
CLINICAL NEUROSCIENCE RESEARCH
CLINICAL NEUROSURGERY
CNS DRUG REVIEWS
CNS DRUGS
CNS NEUROSCIENCE & THERAPEUTICS
COGNITIVE AFFECTIVE & BEHAVIORAL NEUROSCIENCE
COGNITIVE AND BEHAVIORAL NEUROLOGY
COGNITIVE BRAIN RESEARCH
COMMUNICATIONS IN PSYCHOPHARMACOLOGY
CONCEPTS IN NEUROSCIENCE
CONFINIA CEPHALALGICA
CRC CRITICAL REVIEWS IN CLINICAL NEUROBIOLOGY
CRITICAL REVIEWS IN NEUROBIOLOGY
CRITICAL REVIEWS IN NEUROSURGERY

CURRENT ALZHEIMER RESEARCH
CURRENT NEUROLOGY AND NEUROSCIENCE REPORTS
CURRENT NEUROPHARMACOLOGY
CURRENT NEUROVASCULAR RESEARCH
CURRENT OPINION IN NEUROBIOLOGY
CURRENT OPINION IN NEUROLOGY
CURRENT OPINION IN NEUROLOGY AND NEUROSURGERY
CURRENT PAIN AND HEADACHE REPORTS
CURRENT TREATMENT OPTIONS IN NEUROLOGY
DEMENTIA
DEMENTIA AND GERIATRIC COGNITIVE DISORDERS
DEVELOPMENTAL BRAIN DYSFUNCTION
DEVELOPMENTAL BRAIN RESEARCH
DEVELOPMENTAL MEDICINE AND CHILD NEUROLOGY
DEVELOPMENTAL NEUROBIOLOGY
DEVELOPMENTAL NEUROPSYCHOLOGY
DEVELOPMENTAL NEUROSCIENCE
DISCUSSIONS IN NEUROSCIENCE
DISEASES OF THE NERVOUS SYSTEM
DOULEUR ET ANALGESIE
ELECTROENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY
ELECTROMYOGRAPHY AND CLINICAL NEUROPHYSIOLOGY
ELECTROMYOGRAPHY AND MOTOR CONTROL-ELECTROENCEPHALOGRAPHY AND CLINICAL
NEUROPHYSIOLOGY
EPILEPSIA
EPILEPSIES
EPILEPSY RESEARCH
EPILEPTIC DISORDERS
EUROPEAN ARCHIVES OF PSYCHIATRY AND CLINICAL NEUROSCIENCE
EUROPEAN JOURNAL OF NEUROLOGY
EUROPEAN JOURNAL OF NEUROSCIENCE
EUROPEAN JOURNAL OF PAEDIATRIC NEUROLOGY
EUROPEAN JOURNAL OF PAIN
EUROPEAN JOURNAL OF PAIN-LONDON
EUROPEAN NEUROLOGY
EUROPEAN NEUROPSYCHOPHARMACOLOGY
EVOKED POTENTIALS-ELECTROENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY
EXPERIMENTAL BRAIN RESEARCH
EXPERIMENTAL NEUROLOGY
FOCUS ON DEPRESSION AND ANXIETY
FOLIA NEUROPATHOLOGICA
FOLIA PSYCHIATRICA ET NEUROLOGICA JAPONICA
FRONTIERS IN NEUROENDOCRINOLOGY
FUNCTIONAL NEUROLOGY
GENES BRAIN AND BEHAVIOR
GIORNALE DI NEUROPSICHIATRIA DELL ETA EVOLUTIVA
GLIA
HEADACHE
HEADACHE QUARTERLY-CURRENT TREATMENT AND RESEARCH
HIPPOCAMPUS
HOMEOSTASIS IN HEALTH AND DISEASE

HUMAN BRAIN MAPPING
HUMAN NEUROBIOLOGY
IDEGGYOGYASZATI SZEMLE-CLINICAL NEUROSCIENCE
IEEE TRANSACTIONS ON NEURAL SYSTEMS AND REHABILITATION ENGINEERING
INTELLECTUAL AND DEVELOPMENTAL DISABILITIES
INTERNATIONAL JOURNAL OF DEVELOPMENTAL NEUROSCIENCE
INTERNATIONAL JOURNAL OF NEURAL SYSTEMS
INTERNATIONAL JOURNAL OF NEUROPSYCHOPHARMACOLOGY
INTERNATIONAL JOURNAL OF NEURORADIOLOGY
INTERNATIONAL JOURNAL OF NEUROSCIENCE
INTERNATIONAL PHARMACOPSYCHIATRY
INTERNATIONAL REVIEW OF NEUROBIOLOGY
INTERNATIONAL REVIEW OF RESEARCH IN MENTAL RETARDATION
INTERVENTIONAL NEURORADIOLOGY
INVERTEBRATE NEUROSCIENCE
ITALIAN JOURNAL OF NEUROLOGICAL SCIENCES
JAPANESE JOURNAL OF NEUROPSYCHOPHARMACOLOGY
JAPANESE JOURNAL OF PSYCHIATRY AND NEUROLOGY
JOURNAL DE PHYSIOLOGIE
JOURNAL OF ALZHEIMERS DISEASE
JOURNAL OF APPLIED RESEARCH IN INTELLECTUAL DISABILITIES
JOURNAL OF BIOLOGICAL RHYTHMS
JOURNAL OF BRAIN RESEARCH-JOURNAL FUR HIRNFORSCHUNG
JOURNAL OF BRAIN SCIENCE
JOURNAL OF CEREBRAL BLOOD FLOW AND METABOLISM
JOURNAL OF CHEMICAL NEUROANATOMY
JOURNAL OF CHILD AND ADOLESCENT PSYCHOPHARMACOLOGY
JOURNAL OF CHILD NEUROLOGY
JOURNAL OF CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY
JOURNAL OF CLINICAL NEUROLOGY
JOURNAL OF CLINICAL NEUROPHYSIOLOGY
JOURNAL OF CLINICAL NEUROPSYCHOLOGY
JOURNAL OF CLINICAL NEUROSCIENCE
JOURNAL OF CLINICAL PSYCHOPHARMACOLOGY
JOURNAL OF COGNITIVE NEUROSCIENCE
JOURNAL OF COMPARATIVE NEUROLOGY
JOURNAL OF COMPUTATIONAL NEUROSCIENCE
JOURNAL OF EPILEPSY
JOURNAL OF HEADACHE AND PAIN
JOURNAL OF INTELLECTUAL DISABILITY RESEARCH
JOURNAL OF KOREAN NEUROSURGICAL SOCIETY
JOURNAL OF MENTAL DEFICIENCY RESEARCH
JOURNAL OF MOLECULAR NEUROSCIENCE
JOURNAL OF NERVOUS AND MENTAL DISEASE
JOURNAL OF NEURAL ENGINEERING
JOURNAL OF NEURAL TRANSMISSION
JOURNAL OF NEURAL TRANSMISSION-GENERAL SECTION
JOURNAL OF NEURAL TRANSMISSION-PARKINSONS DISEASE AND DEMENTIA SECTION
JOURNAL OF NEURAL TRANSMISSION-SUPPLEMENTUM
JOURNAL OF NEURAL TRANSPLANTATION & PLASTICITY
JOURNAL OF NEUROBIOLOGY

JOURNAL OF NEUROCHEMISTRY
JOURNAL OF NEUROCYTOLOGY
JOURNAL OF NEUROENDOCRINOLOGY
JOURNAL OF NEUROGENETICS
JOURNAL OF NEUROIMAGING
JOURNAL OF NEUROIMMUNE PHARMACOLOGY
JOURNAL OF NEUROIMMUNOLOGY
JOURNAL OF NEUROINFLAMMATION
JOURNAL OF NEUROLINGUISTICS
JOURNAL OF NEUROLOGICAL AND ORTHOPAEDIC MEDICINE AND SURGERY
JOURNAL OF NEUROLOGICAL SCIENCES-TURKISH
JOURNAL OF NEUROLOGY
JOURNAL OF NEUROLOGY NEUROSURGERY AND PSYCHIATRY
JOURNAL OF NEURO-ONCOLOGY
JOURNAL OF NEUROPATHOLOGY AND EXPERIMENTAL NEUROLOGY
JOURNAL OF NEUROPHYSIOLOGY
JOURNAL OF NEUROPSYCHIATRY AND CLINICAL NEUROSCIENCES
JOURNAL OF NEURORADIOLOGY
JOURNAL OF NEUROSCIENCE
JOURNAL OF NEUROSCIENCE METHODS
JOURNAL OF NEUROSCIENCE NURSING
JOURNAL OF NEUROSCIENCE RESEARCH
JOURNAL OF NEUROSURGERY
JOURNAL OF NEUROSURGERY-PEDIATRICS
JOURNAL OF NEUROSURGERY-SPINE
JOURNAL OF NEUROSURGICAL SCIENCES
JOURNAL OF NEUROTRAUMA
JOURNAL OF NEUROVIROLOGY
JOURNAL OF PAIN
JOURNAL OF PAIN AND SYMPTOM MANAGEMENT
JOURNAL OF PHYSIOLOGY-PARIS
JOURNAL OF PSYCHIATRY & NEUROSCIENCE
JOURNAL OF SLEEP RESEARCH
JOURNAL OF SPINAL CORD MEDICINE
JOURNAL OF THE AUTONOMIC NERVOUS SYSTEM
JOURNAL OF THE HISTORY OF THE NEUROSCIENCES
JOURNAL OF THE INTERNATIONAL NEUROPSYCHOLOGICAL SOCIETY
JOURNAL OF THE NEUROLOGICAL SCIENCES
JOURNAL OF THE PERIPHERAL NERVOUS SYSTEM
JOURNAL OF THEORETICAL NEUROBIOLOGY
KLINISCHE NEUROPHYSIOLOGIE
KLINISCHE NEURORADIOLOGIE
LANCET NEUROLOGY
MENTAL HANDICAP RESEARCH
MENTAL RETARDATION
MENTAL RETARDATION AND DEVELOPMENTAL DISABILITIES RESEARCH REVIEWS
METABOLIC BRAIN DISEASE
MINIMALLY INVASIVE NEUROSURGERY
MOLECULAR AND CELLULAR NEUROSCIENCES
MOLECULAR AND CHEMICAL NEUROPATHOLOGY
MOLECULAR BRAIN RESEARCH

MOLECULAR NEUROBIOLOGY
MOLECULAR PAIN
NATURE REVIEWS NEUROSCIENCE
NERVENHEILKUNDE
NEURAL COMPUTATION
NEURAL NETWORK WORLD
NEURAL PLASTICITY
NEUROBEHAVIORAL TOXICOLOGY
NEUROBEHAVIORAL TOXICOLOGY AND TERATOLOGY
NEUROBIOLOGY
NEUROBIOLOGY OF AGING
NEUROBIOLOGY OF DISEASE
NEUROBIOLOGY OF LEARNING AND MEMORY
NEUROBIOLOGY-BUDAPEST
NEUROCASE
NEUROCHEMICAL JOURNAL
NEUROCHEMICAL PATHOLOGY
NEUROCHEMICAL RESEARCH
NEUROCHEMISTRY INTERNATIONAL
NEUROCIROGIA
NEUROCOMPUTING
NEUROCRITICAL CARE
NEURODEGENERATION
NEURODEGENERATIVE DISEASES
NEUROENDOCRINOLOGY
NEUROENDOCRINOLOGY LETTERS
NEUROEPIDEMIOLOGY
NEUROFORUM
NEUROGASTROENTEROLOGY AND MOTILITY
NEUROGENETICS
NEUROIMAGE
NEUROIMAGING CLINICS OF NORTH AMERICA
NEUROIMMUNOMODULATION
NEUROINFORMATICS
NEUROLOGIA
NEUROLOGIA CROATICA
NEUROLOGIA MEDICO-CHIRURGICA
NEUROLOGIC CLINICS
NEUROLOGICAL RESEARCH
NEUROLOGICAL SCIENCES
NEUROLOGICAL SURGERY
NEUROLOGIST
NEUROLOGY
NEUROLOGY ASIA
NEUROLOGY INDIA
NEUROLOGY PSYCHIATRY AND BRAIN RESEARCH
NEUROMODULATION
NEUROMOLECULAR MEDICINE
NEUROMUSCULAR DISORDERS
NEURON
NEURON GLIA BIOLOGY

NEURO-ONCOLOGY
NEURO-OPHTHALMOLOGY
NEURO-ORTHOPEDECS
NEUROPADIATRIE
NEUROPATHOLOGY AND APPLIED NEUROBIOLOGY
NEUROPEDIATRICS
NEUROPEPTIDES
NEUROPHARMACOLOGY
NEUROPHYSIOLOGIE CLINIQUE-CLINICAL NEUROPHYSIOLOGY
NEUROPHYSIOLOGY
NEUROPROTOCOLS-A COMPANION TO METHODS IN NEUROSCIENCES
NEUROPSYCHIATRIE
NEUROPSYCHIATRIE DE L ENFANCE ET DE L ADOLESCENCE
NEUROPSYCHIATRY NEUROPSYCHOLOGY AND BEHAVIORAL NEUROLOGY
NEUROPSYCHOBIOLOGY
NEUROPSYCHOLOGIA
NEUROPSYCHOLOGICAL REHABILITATION
NEUROPSYCHOLOGY
NEUROPSYCHOLOGY REVIEW
NEUROPSYCHOPHARMACOLOGY
NEUROQUANTOLOGY
NEURORADIOLOGY
NEUOREHABILITATION
NEUOREHABILITATION AND NEURAL REPAIR
NEUOREPORT
NEUROSCIENCE
NEUROSCIENCE AND BIOBEHAVIORAL REVIEWS
NEUROSCIENCE LETTERS
NEUROSCIENCE RESEARCH
NEUROSCIENCE RESEARCH COMMUNICATIONS
NEUROSCIENCES
NEUROSCIENCES RESEARCH PROGRAM BULLETIN
NEUROSCIENCES-JAPAN
NEUROSCIENTIST
NEURO SIGNALS
NEUROSURGERY
NEUROSURGERY CLINICS OF NORTH AMERICA
NEUROSURGERY QUARTERLY
NEUROSURGICAL FOCUS
NEUROSURGICAL REVIEW
NEURO THERAPEUTICS
NEUROTOXICITY RESEARCH
NEUROTOXICOLOGY
NEUROTOXICOLOGY AND TERATOLOGY
NEUROUROLOGY AND URODYNAMICS
NIMHANS JOURNAL
NUTRITIONAL NEUROSCIENCE
PAIN
PAIN CLINIC
PAIN FORUM
PAIN PHYSICIAN

PAIN REVIEWS
PARAPLEGIA
PARKINSONISM & RELATED DISORDERS
PEDIATRIC NEUROLOGY
PEDIATRIC NEUROSCIENCE
PEDIATRIC NEUROSURGERY
PERSPECTIVES IN NEUROLOGICAL SURGERY
PERSPECTIVES ON DEVELOPMENTAL NEUROBIOLOGY
PHARMACOPSYCHIATRIA
PHARMACOPSYCHIATRY
PHARMAKOPSYCHIATRIE NEURO-PSYCHOPHARMAKOLOGIE
PHYSIOLOGIA BOHEMOSLOVACA
PROGRESS IN BRAIN RESEARCH
PROGRESS IN CLINICAL NEUROPHYSIOLOGY
PROGRESS IN NEUROBIOLOGY
PROGRESS IN NEUROENDOCRINIMMUNOLOGY
PROGRESS IN NEUROPATHOLOGY
PROGRESS IN NEURO-PSYCHOPHARMACOLOGY
PROGRESS IN NEURO-PSYCHOPHARMACOLOGY & BIOLOGICAL PSYCHIATRY
PROGRESS IN PSYCHOBIOLOGY AND PHYSIOLOGICAL PSYCHOLOGY
PSN-PSYCHIATRIE SCIENCES HUMAINES NEUROSCIENCES
PSYCHIATRIC GENETICS
PSYCHIATRY AND CLINICAL NEUROSCIENCES
PSYCHIATRY RESEARCH-NEUROIMAGING
PSYCHOLOGIE & NEUROPSYCHIATRIE DU VIEILLISSEMENT
PSYCHONEUROENDOCRINOLOGY
PSYCHOPHARMACOLOGY
PSYCHOPHARMACOLOGY BULLETIN
PURINERGIC SIGNALLING
RESEARCH IN DEVELOPMENTAL DISABILITIES
RESTORATIVE NEUROLOGY AND NEUROSCIENCE
REVIEWS IN THE NEUROSCIENCES
REVISTA DE NEUROLOGIA
REVISTA ECUATORIANA DE NEUROLOGIA
REVUE D ELECTROENCEPHALOGRAPHIE ET DE NEUROPHYSIOLOGIE CLINIQUE
REVUE DE NEUROPSYCHIATRIE INFANTILE ET D HYGIENE MENTALE DE L ENFANCE
REVUE NEUROLOGIQUE
RIVISTA DI NEURORADIOLOGIA
SEIZURE
SEIZURE-EUROPEAN JOURNAL OF EPILEPSY
SEMINARS IN NEUROLOGY
SEMINARS IN THE NEUROSCIENCES
SLEEP
SLEEP AND BIOLOGICAL RHYTHMS
SLEEP MEDICINE
SLEEP MEDICINE REVIEWS
SOCIAL COGNITIVE AND AFFECTIVE NEUROSCIENCE
SOCIAL NEUROSCIENCE
SOMATOSENSORY AND MOTOR RESEARCH
SOMATOSENSORY RESEARCH
STEREOTACTIC AND FUNCTIONAL NEUROSURGERY

STROKE
SURGICAL NEUROLOGY
SYNAPSE
TECHNIQUES IN NEUROSURGERY
TOPICS IN STROKE REHABILITATION
TRANSACTIONS OF THE AMERICAN NEUROLOGICAL ASSOCIATION
TRENDS IN NEUROSCIENCES
TURKISH NEUROSURGERY
VISION RESEARCH
VISUAL NEUROSCIENCE
ZEITSCHRIFT FUR DIE GESAMTE NEUROLOGIE UND PSYCHIATRIE
ZENTRALBLATT FUR NEUROCHIRURGIE

Neuroimaging

AMERICAN JOURNAL OF NEURORADIOLOGY
INTERNATIONAL JOURNAL OF NEURORADIOLOGY
INTERVENTIONAL NEURORADIOLOGY
JOURNAL OF NEUROIMAGING
JOURNAL OF NEURORADIOLOGY
KLINISCHE NEURORADIOLOGIE
KLINISCHE NEURORADIOLOGIE
NEUROIMAGING CLINICS OF NORTH AMERICA
NEURORADIOLOGY
PSYCHIATRY RESEARCH-NEUROIMAGING
RIVISTA DI NEURORADIOLOGIA

Mental Health

ACTA PSYCHIATRICA SCANDINAVICA
ACTAS ESPANOLAS DE PSIQUIATRIA
ACTAS LUSO-ESPANOLAS DE NEUROLOGIA PSIQUIATRIA Y CIENCIAS AFINES
ADVANCES IN PSYCHOSOMATIC MEDICINE
ALZHEIMER DISEASE & ASSOCIATED DISORDERS
AMERICAN JOURNAL OF ALZHEIMERS DISEASE AND OTHER DEMENTIAS
AMERICAN JOURNAL OF GERIATRIC PSYCHIATRY
AMERICAN JOURNAL OF ORTHOPSYCHIATRY
AMERICAN JOURNAL OF PSYCHIATRY
AMERICAN JOURNAL OF PSYCHOTHERAPY
AMERICAN JOURNAL ON MENTAL RETARDATION
ANXIETY STRESS AND COPING
ARCHIVES OF GENERAL PSYCHIATRY
ARCHIVES OF PSYCHIATRIC NURSING
ARCHIVES OF WOMENS MENTAL HEALTH
ARQUIVOS DE NEURO-PSIQUIATRIA
AUSTRALASIAN PSYCHIATRY
AUSTRALIAN AND NEW ZEALAND JOURNAL OF PSYCHIATRY
AUTISM
BEHAVIORAL MEDICINE
BIOLOGICAL PSYCHIATRY
BIPOLAR DISORDERS
BRITISH JOURNAL OF MEDICAL PSYCHOLOGY

BRITISH JOURNAL OF PSYCHIATRY
BULLETIN OF THE MENNINGER CLINIC
CANADIAN JOURNAL OF PSYCHIATRY-REVUE CANADIENNE DE PSYCHIATRIE
CHILD AND ADOLESCENT PSYCHIATRIC CLINICS OF NORTH AMERICA
CNS SPECTRUMS
COMMUNITY MENTAL HEALTH JOURNAL
COMPREHENSIVE PSYCHIATRY
CONVULSIVE THERAPY
CORTEX
CURRENT OPINION IN PSYCHIATRY
DEMENTIA AND GERIATRIC COGNITIVE DISORDERS
DEPRESSION AND ANXIETY
DEVELOPMENTAL DISABILITIES RESEARCH REVIEWS
DYSLEXIA
EATING AND WEIGHT DISORDERS-STUDIES ON ANOREXIA BULIMIA AND OBESITY
ENCEPHALE-REVUE DE PSYCHIATRIE CLINIQUE BIOLOGIQUE ET THERAPEUTIQUE
EPIDEMIOLOGIA E PSICHIATRIA SOCIALE-AN INTERNATIONAL JOURNAL FOR EPIDEMIOLOGY AND
PSYCHIATRIC SCIENCES
EPILEPSY & BEHAVIOR
EUROPEAN CHILD & ADOLESCENT PSYCHIATRY
EUROPEAN PSYCHIATRY
GENERAL HOSPITAL PSYCHIATRY
HARVARD REVIEW OF PSYCHIATRY
INTELLECTUAL AND DEVELOPMENTAL DISABILITIES
INTERNATIONAL CLINICAL PSYCHOPHARMACOLOGY
INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL HYPNOSIS
INTERNATIONAL JOURNAL OF EATING DISORDERS
INTERNATIONAL JOURNAL OF GERIATRIC PSYCHIATRY
INTERNATIONAL JOURNAL OF MENTAL HEALTH
INTERNATIONAL JOURNAL OF METHODS IN PSYCHIATRIC RESEARCH
INTERNATIONAL JOURNAL OF PSYCHIATRY IN MEDICINE
INTERNATIONAL JOURNAL OF PSYCHOANALYSIS
INTERNATIONAL JOURNAL OF SOCIAL PSYCHIATRY
INTERNATIONAL PSYCHOGERIATRICS
INTERNATIONAL REVIEW OF PSYCHIATRY
IRISH JOURNAL OF PSYCHOLOGICAL MEDICINE
ISRAEL JOURNAL OF PSYCHIATRY AND RELATED SCIENCES
JOURNAL OF AFFECTIVE DISORDERS
JOURNAL OF ALZHEIMERS DISEASE
JOURNAL OF ANXIETY DISORDERS
JOURNAL OF AUTISM AND DEVELOPMENTAL DISORDERS
JOURNAL OF BEHAVIOR THERAPY AND EXPERIMENTAL PSYCHIATRY
JOURNAL OF CHILD AND ADOLESCENT PSYCHOPHARMACOLOGY
JOURNAL OF CLINICAL PSYCHIATRY
JOURNAL OF ECT
JOURNAL OF GERIATRIC PSYCHIATRY AND NEUROLOGY
JOURNAL OF INTELLECTUAL DISABILITY RESEARCH
JOURNAL OF LEARNING DISABILITIES
JOURNAL OF MENTAL HEALTH POLICY AND ECONOMICS
JOURNAL OF NERVOUS AND MENTAL DISEASE
JOURNAL OF NEUROPSYCHIATRY AND CLINICAL NEUROSCIENCES

JOURNAL OF PERSONALITY DISORDERS
JOURNAL OF PSYCHIATRIC PRACTICE
JOURNAL OF PSYCHIATRIC RESEARCH
JOURNAL OF PSYCHIATRY & NEUROSCIENCE
JOURNAL OF PSYCHOSOMATIC OBSTETRICS AND GYNECOLOGY
JOURNAL OF PSYCHOSOMATIC RESEARCH
JOURNAL OF THE AMERICAN ACADEMY OF CHILD AND ADOLESCENT PSYCHIATRY
JOURNAL OF THE AMERICAN PSYCHOANALYTIC ASSOCIATION
JOURNAL OF TRAUMATIC STRESS
MENTAL RETARDATION
MOLECULAR PSYCHIATRY
MOOD DISORDERS
NEUROPSYCHIATRIE
NEUROPSYCHIATRY NEUROPSYCHOLOGY AND BEHAVIORAL NEUROLOGY
NEUROPSYCHOBIOLOGY
NORDIC JOURNAL OF PSYCHIATRY
PHARMACOPSYCHIATRY
PRAXIS DER KINDERPSYCHOLOGIE UND KINDERPSYCHIATRIE
PSYCHIATRIA DANUBINA
PSYCHIATRIA POLSKA
PSYCHIATRIC ANNALS
PSYCHIATRIC CLINICS OF NORTH AMERICA
PSYCHIATRIC QUARTERLY
PSYCHIATRIC SERVICES
PSYCHIATRISCHE PRAXIS
PSYCHIATRY AND CLINICAL NEUROSCIENCES
PSYCHIATRY RESEARCH
PSYCHIATRY RESEARCH-NEUROIMAGING
PSYCHIATRY-INTERPERSONAL AND BIOLOGICAL PROCESSES
PSYCHOLOGICAL MEDICINE
PSYCHOLOGIE & NEUROPSYCHIATRIE DU VIEILLISSEMENT
PSYCHOLOGY AND PSYCHOTHERAPY-THEORY RESEARCH AND PRACTICE
PSYCHOPATHOLOGY
PSYCHOPHARMACOLOGY BULLETIN
PSYCHOSOMATIC MEDICINE
PSYCHOSOMATICS
PSYCHOTHERAPY AND PSYCHOSOMATICS
RESEARCH IN DEVELOPMENTAL DISABILITIES
REVISTA BRASILEIRA DE PSIQUIATRIA
SCHIZOPHRENIA BULLETIN
SCHIZOPHRENIA RESEARCH
SOCIAL PSYCHIATRY AND PSYCHIATRIC EPIDEMIOLOGY
STRESS MEDICINE
SUICIDE AND LIFE-THREATENING BEHAVIOR
TRANSCULTURAL PSYCHIATRY
TURK PSIKIYATRI DERGISI
WORLD JOURNAL OF BIOLOGICAL PSYCHIATRY
ZEITSCHRIFT FUR KINDER-UND JUGENDPSYCHIATRIE UND PSYCHOTHERAPIE
ZEITSCHRIFT FUR PSYCHOSOMATISCHE MEDIZIN UND PSYCHOANALYSE
ZHURNAL NEVROLOGII I PSIKHIATRII IMENI S S KORSAKOVA

Addiction

ADDICTION
ADDICTION BIOLOGY
ADDICTION RESEARCH
ADDICTION RESEARCH & THEORY
ADDICTIVE BEHAVIORS
ADDICTIVE DISEASES
ADICCIONES
ALCOHOL
ALCOHOL AND ALCOHOLISM
ALCOHOL AND DRUG RESEARCH
ALCOHOL HEALTH & RESEARCH WORLD
ALCOHOL RESEARCH & HEALTH
ALCOHOLISM-CLINICAL AND EXPERIMENTAL RESEARCH
AMERICAN INDIAN AND ALASKA NATIVE MENTAL HEALTH RESEARCH
AMERICAN JOURNAL OF DRUG AND ALCOHOL ABUSE
AMERICAN JOURNAL ON ADDICTIONS
BRITISH JOURNAL OF ADDICTION
BRITISH JOURNAL ON ALCOHOL AND ALCOHOLISM
BULLETIN ON NARCOTICS
CONTEMPORARY DRUG PROBLEMS
DRUG AND ALCOHOL DEPENDENCE
DRUG AND ALCOHOL REVIEW
DRUGS-EDUCATION PREVENTION AND POLICY
EUROPEAN ADDICTION RESEARCH
INTERNATIONAL JOURNAL OF THE ADDICTIONS
JOURNAL OF ADDICTION MEDICINE
JOURNAL OF ADDICTIONS NURSING
JOURNAL OF ADDICTIVE DISEASES
JOURNAL OF ALCOHOL AND DRUG EDUCATION
JOURNAL OF CHILD & ADOLESCENT SUBSTANCE ABUSE
JOURNAL OF DRUG EDUCATION
JOURNAL OF DRUG ISSUES
JOURNAL OF GAMBLING STUDIES
JOURNAL OF PSYCHEDELIC DRUGS
JOURNAL OF PSYCHOACTIVE DRUGS
JOURNAL OF STUDIES ON ALCOHOL
JOURNAL OF STUDIES ON ALCOHOL AND DRUGS
JOURNAL OF SUBSTANCE ABUSE
JOURNAL OF SUBSTANCE ABUSE TREATMENT
PSICOTHEMA
RESEARCH ADVANCES IN ALCOHOL AND DRUG PROBLEMS
RESEARCH COMMUNICATIONS IN ALCOHOL AND SUBSTANCES OF ABUSE
RESEARCH COMMUNICATIONS IN SUBSTANCES OF ABUSE
REVUE DE L'ALCOOLISME
SUBSTANCE USE & MISUSE
TOXICOMANIES

Senses and Communication Disorders

ACTA OPHTHALMOLOGICA
ACTA OPHTHALMOLOGICA SCANDINAVICA
ADVANCES IN PAIN RESEARCH AND THERAPY
AMERICAN ANNALS OF THE DEAF
AMERICAN JOURNAL OF OPHTHALMOLOGY
AMERICAN JOURNAL OF OPTOMETRY AND PHYSIOLOGICAL OPTICS

AMERICAN JOURNAL OF SPEECH-LANGUAGE PATHOLOGY
ANESTHESIA AND ANALGESIA
ANNALS OF OPHTHALMOLOGY
ANNALS OF OPHTHALMOLOGY & GLAUCOMA
ANNALS OF OPHTHALMOLOGY-GLAUCOMA
APHASIOLOGY
APPLIED PSYCHOLINGUISTICS
ARCHIVES D OPHTALMOLOGIE
ARCHIVES OF OPHTHALMOLOGY
AUDIOLOGY
AUDIOLOGY AND NEURO-OTOLOGY
AUDITORY NEUROSCIENCE
AUGMENTATIVE AND ALTERNATIVE COMMUNICATION
AUSTRALIAN AND NEW ZEALAND JOURNAL OF OPHTHALMOLOGY
AUSTRALIAN JOURNAL OF OPHTHALMOLOGY
B-ENT
BRITISH JOURNAL OF AUDIOLOGY
BRITISH JOURNAL OF DISORDERS OF COMMUNICATION
BRITISH JOURNAL OF OPHTHALMOLOGY
CANADIAN JOURNAL OF OPHTHALMOLOGY-JOURNAL CANADIEN D OPHTALMOLOGIE
CHEMICAL SENSES
CHEMICAL SENSES & FLAVOUR
CLINICAL AND EXPERIMENTAL OPHTHALMOLOGY
CLINICAL AND EXPERIMENTAL OPTOMETRY
CLINICAL JOURNAL OF PAIN
CLINICAL LINGUISTICS & PHONETICS
CLINICAL VISION SCIENCES
COMMUNICATION AND COGNITION
CORNEA
CURRENT EYE RESEARCH
CURRENT OPINION IN OPHTHALMOLOGY
CURRENT PAIN AND HEADACHE REPORTS
DEAFNESS AND EDUCATION
DEVELOPMENTS IN OPHTHALMOLOGY
DOCUMENTA OPHTHALMOLOGICA
DOULEUR ET ANALGESIE
EAR AND HEARING
EAR NOSE & THROAT JOURNAL
ENT-EAR NOSE & THROAT JOURNAL
EUROPEAN JOURNAL OF DISORDERS OF COMMUNICATION
EUROPEAN JOURNAL OF OPHTHALMOLOGY
EUROPEAN JOURNAL OF PAIN
EUROPEAN JOURNAL OF PAIN-LONDON
EXPERIMENTAL EYE RESEARCH
EYE
EYE & CONTACT LENS-SCIENCE AND CLINICAL PRACTICE
EYE EAR NOSE AND THROAT MONTHLY
EYE-TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETIES OF THE UNITED KINGDOM
FOLIA OPHTHALMOLOGICA JAPONICA
GERMAN JOURNAL OF OPHTHALMOLOGY
GRAEFES ARCHIVE FOR CLINICAL AND EXPERIMENTAL OPHTHALMOLOGY

HEADACHE
HEADACHE QUARTERLY-CURRENT TREATMENT AND RESEARCH
HEARING RESEARCH
INDIAN JOURNAL OF OPHTHALMOLOGY
INTERNATIONAL JOURNAL OF AUDIOLOGY
INTERNATIONAL JOURNAL OF LANGUAGE & COMMUNICATION DISORDERS
INTERNATIONAL OPHTHALMOLOGY
INTERNATIONAL OPHTHALMOLOGY CLINICS
INVESTIGATIVE OPHTHALMOLOGY
INVESTIGATIVE OPHTHALMOLOGY & VISUAL SCIENCE
IRANIAN JOURNAL OF OPHTHALMOLOGY
JAPANESE JOURNAL OF OPHTHALMOLOGY
JOURNAL FRANCAIS D OPHTALMOLOGIE
JOURNAL OF CATARACT AND REFRACTIVE SURGERY
JOURNAL OF CHILD LANGUAGE
JOURNAL OF CLINICAL NEURO-OPHTHALMOLOGY
JOURNAL OF COMMUNICATION DISORDERS
JOURNAL OF DEAF STUDIES AND DEAF EDUCATION
JOURNAL OF FLUENCY DISORDERS
JOURNAL OF GLAUCOMA
JOURNAL OF HEADACHE AND PAIN
JOURNAL OF MUSCULOSKELETAL PAIN
JOURNAL OF NEUROLINGUISTICS
JOURNAL OF NEURO-OPHTHALMOLOGY
JOURNAL OF OROFACIAL PAIN
JOURNAL OF PAIN
JOURNAL OF PAIN AND SYMPTOM MANAGEMENT
JOURNAL OF PEDIATRIC OPHTHALMOLOGY & STRABISMUS
JOURNAL OF PHONETICS
JOURNAL OF REHABILITATION OF THE DEAF
JOURNAL OF REHABILITATION RESEARCH AND DEVELOPMENT
JOURNAL OF SPEECH AND HEARING DISORDERS
JOURNAL OF SPEECH AND HEARING RESEARCH
JOURNAL OF SPEECH LANGUAGE AND HEARING RESEARCH
JOURNAL OF THE AMERICAN ACADEMY OF AUDIOLOGY
JOURNAL OF THE AMERICAN AUDITORY SOCIETY
JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION
JOURNAL OF THE BRITISH ASSOCIATION OF TEACHERS OF THE DEAF
JOURNAL OF TOXICOLOGY-CUTANEOUS AND OCULAR TOXICOLOGY
JOURNAL OF VESTIBULAR RESEARCH-EQUILIBRIUM & ORIENTATION
JOURNAL OF VISION
JOURNAL OF VISUAL IMPAIRMENT & BLINDNESS
JOURNAL OF VOICE
LOGOPEDICS PHONIATRICES VOICOLOGY
METABOLIC AND PEDIATRIC OPHTHALMOLOGY
METABOLIC PEDIATRIC AND SYSTEMIC OPHTHALMOLOGY
MOLECULAR PAIN
OCULAR IMMUNOLOGY AND INFLAMMATION
OCULAR SURFACE
OPHTHALMIC AND PHYSIOLOGICAL OPTICS
OPHTHALMIC EPIDEMIOLOGY

OPHTHALMIC GENETICS
OPHTHALMIC RESEARCH
OPHTHALMIC SURGERY AND LASERS
OPHTHALMIC SURGERY LASERS & IMAGING
OPHTHALMOLOGE
OPHTHALMOLOGICA
OPHTHALMOLOGY
OPTOMETRY AND VISION SCIENCE
PAIN
PAIN CLINIC
PAIN FORUM
PAIN MANAGEMENT NURSING
PAIN MEDICINE
PAIN PHYSICIAN
PAIN REVIEWS
PHONETICA
PROGRESS IN RETINAL AND EYE RESEARCH
PROGRESS IN RETINAL RESEARCH
REFRACTIVE AND CORNEAL SURGERY
REGIONAL ANESTHESIA AND PAIN MEDICINE
RETINA-THE JOURNAL OF RETINAL AND VITREOUS DISEASES
SCANDINAVIAN AUDIOLOGY
SPATIAL VISION
SPEECH COMMUNICATION
SPRACHE-STIMME-GEHOR
SURVEY OF OPHTHALMOLOGY
TOPICS IN LANGUAGE DISORDERS
TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETIES OF THE UNITED KINGDOM
VISION RESEARCH
VISUAL COGNITION
VISUAL NEUROSCIENCE
VOLTA REVIEW

Pain

ADVANCES IN PAIN RESEARCH AND THERAPY
ANESTHESIA AND ANALGESIA
CLINICAL JOURNAL OF PAIN
CURRENT PAIN AND HEADACHE REPORTS
DOULEUR ET ANALGESIE
EUROPEAN JOURNAL OF PAIN
EUROPEAN JOURNAL OF PAIN-LONDON
HEADACHE
HEADACHE QUARTERLY-CURRENT TREATMENT AND RESEARCH
JOURNAL OF HEADACHE AND PAIN
JOURNAL OF MUSCULOSKELETAL PAIN
JOURNAL OF OROFACIAL PAIN
JOURNAL OF PAIN
JOURNAL OF PAIN AND SYMPTOM MANAGEMENT
MOLECULAR PAIN
PAIN
PAIN CLINIC

PAIN FORUM
PAIN MANAGEMENT NURSING
PAIN MEDICINE
PAIN PHYSICIAN
PAIN REVIEWS
REGIONAL ANESTHESIA AND PAIN MEDICINE

Regenerative Medicine

ARTIFICIAL ORGANS
BIOMATERIALS ARTIFICIAL CELLS AND ARTIFICIAL ORGANS
BIOMATERIALS ARTIFICIAL CELLS AND IMMOBILIZATION BIOTECHNOLOGY
BIOMATERIALS MEDICAL DEVICES AND ARTIFICIAL ORGANS
CELL STEM CELL
CLONING AND STEM CELLS
INTERNATIONAL JOURNAL OF ARTIFICIAL ORGANS
JOURNAL OF ARTIFICIAL ORGANS
JOURNAL OF TISSUE ENGINEERING AND REGENERATIVE MEDICINE
NEURAL REGENERATION RESEARCH
REGENERATIVE MEDICINE
STEM CELL REVIEWS
STEM CELLS
STEM CELLS AND DEVELOPMENT
TISSUE ENGINEERING
TISSUE ENGINEERING AND REGENERATIVE MEDICINE
TISSUE ENGINEERING PART A
TISSUE ENGINEERING PART B-REVIEWS
TISSUE ENGINEERING PART C-METHODS
TRANSACTIONS AMERICAN SOCIETY FOR ARTIFICIAL INTERNAL ORGANS
WOUND REPAIR AND REGENERATION

Nanomedicine

DIGEST JOURNAL OF NANOMATERIALS AND BIOSTRUCTURES
IEE PROCEEDINGS-NANOBIO TECHNOLOGY
IEEE TRANSACTIONS ON NANOBIO SCIENCE
IET NANOBIO TECHNOLOGY
INTERNATIONAL JOURNAL OF NANOMEDICINE
JOURNAL OF BIOMEDICAL NANOTECHNOLOGY
MICROFLUIDICS AND NANOFUIDICS
NANO BIOLOGY
NANOMEDICINE
NANOMEDICINE-NANOTECHNOLOGY BIOLOGY AND MEDICINE
NANOTOXICOLOGY
NATURE NANOTECHNOLOGY

Epigenetics

EPIGENETICS



Observatoire
des **sciences** et des
technologies

Address

Observatoire des sciences et des technologies
Centre interuniversitaire de recherche sur la science et la technologie
Université du Québec à Montréal
CP 8888, Succ. Centre-ville
Montréal (Québec)
H3C 3P8

www.ost.qc.ca